The D. H. Hill Library

North Carolina State College

SB249
W34

N.C. STATE UNIVERSITY D.H. HILL LIBRARY
S00222283 J

SB249 37617
W34 Watt.
The wild an
vated cotton pl
the world

37617

This book may be kept out TWO WEEKS ONLY, and is subject to a fine of FIVE CENTS a day thereafter. It is due on the day indicated below:

24Sep'62	IL 8407677
AUG 1 1967	DLM 8/23/94
[redacted]	MAY 1
	JUL 17 1994
	MAY 18 1995
	DEC 15 1995
SEP 10 1977	DEC 18 1996
APR 12 1978	
FEB 27 1980	
SEP 12 1984	DEC 13 1999
JAN 10 1990	
APR 25 1992	

7Aug'57H
10Aug'[redacted]
30May'58 E
3May'60F
3Nov60A
13Dec60A
16Feb'61
5Jan'61
MAR 30 1962
2May65
18Nov'62 7

I.L.L. Duke
Durham N.

50M—O48—Form 3

THE
WILD AND CULTIVATED COTTON PLANTS
OF THE WORLD

No. 1. GOSSYPIUM VITIFOLIUM, *LAMK.*

Original MS. Sketch made by Ehret in 1766 : preserved in the Library, Botanical Department, British Museum.

THE

WILD AND CULTIVATED

COTTON PLANTS

OF

THE WORLD

A REVISION OF THE GENUS GOSSYPIUM

FRAMED PRIMARILY
WITH THE OBJECT OF AIDING PLANTERS AND
INVESTIGATORS WHO MAY CONTEMPLATE THE SYSTEMATIC
IMPROVEMENT OF THE COTTON STAPLE

BY

SIR GEORGE WATT

C.I.E., M.B., C.M., LL.D. (ABD. AND GLASG.), F.L.S.

OFFICIER D'ACADÉMIE
CORRESPONDING MEMBER ROYAL HORTICULTURAL SOCIETY OF ENGLAND
HONORARY MEMBER OF THE PHARMACEUTICAL SOCIETY OF GREAT BRITAIN
DANIEL HANBURY GOLD MEDALLIST
FORMERLY
PROFESSOR OF BOTANY CALCUTTA UNIVERSITY, AND REPORTER ON ECONOMIC PRODUCTS
TO THE GOVERNMENT OF INDIA

LONGMANS, GREEN, AND CO.
39 PATERNOSTER ROW, LONDON
NEW YORK, BOMBAY, AND CALCUTTA
1907

All rights reserved

DEDICATED

WITH GRATITUDE AND RESPECT

TO

SIR JOSEPH DALTON HOOKER

G.C.S.I., C.B., M.D., F.R.S., D.C.L., LL.D., &c.

THROUGH WHOSE KIND ENCOURAGEMENT

THIS MONOGRAPH

HAS BEEN PUBLISHED

SB 249
W37

37617

PREFACE

A good many years ago Sir E. C. Buck, K.C.S.I., then Secretary to the Government of India in the Department of Revenue and Agriculture, requested me to prepare an account of the cotton plants of the world with a view to assisting the Indian planters. I devoted some time and attention to the subject, during a recess from India, spent at Kew Gardens, and even had some of the illustrations prepared which are now published. The pressure of official duties that devolved upon me on my return to India retarded very greatly the completion of my studies, and perhaps fortunately so, since I was enabled to mature my conceptions of the species and varieties of *Gossypium* and to verify and amplify my original notes. The present publication thus incorporates the field studies of perhaps twenty years, linked up with the results of a careful re-examination of the collections preserved in some of the chief herbaria of the world.

I have to acknowledge a deep debt of gratitude to the former and the present Director of the Royal Gardens, Kew (Sir William Thiselton-Dyer, K.C.M.G., and now Colonel D. Prain, C.I.E.), for much personal kindness and valued encouragement. To the Keepers of the Kew Gardens and the British Museum Herbaria (Mr. William Botting Hemsley and Dr. Alfred Barton Rendle) I am specially indebted for not only giving me every facility to examine but (where I desired) permission to photograph the rich treasures under their charge. To the Council of the Linnean Society of London I have to record my acknowledgments for the ready permission granted me to photograph the Linnean types, and to the Keeper of the British Museum for the corresponding liberty to photograph the types in the Sloane Herbarium and to reproduce Ehret's most interesting and beautiful unpublished sketch of a cotton, which I give as the frontispiece of this work.

It would be invidious to mention by name the members of the staff in the various public institutions already indicated who have all been most considerate and helpful to me, but I must make one exception: Mr. James Britten, of the British Museum, was untiring in his efforts to enable me to see the more interesting specimens in that herbarium, and without whose unique knowledge of the collections, and especially of the penmanship of authors, it would have been impossible for me to fix the ownership of some of the historic examples of *Gossypium* that it was most necessary I should ascertain.

But, without the liberal assistance of the owners and curators of other great herbaria, my humble attempt at a revision of the genus *Gossypium* would have been bereft of much of the interest that it may be found to possess. I would specially mention M. Casimir de Candolle, of Geneva, for having forwarded a set of the specimens from his historic herbarium. I am greatly indebted to Mr. B. T. Galloway, Chief, and to Mr. Lyster H. Dewey, Botanist in charge of Fibre Plants of the Bureau of Plant Industry, for having sent for my inspection two very large and extremely beautiful sets of the typical cottons grown in the United States of America. Mr. Dewey has, moreover, favoured me with several instructive letters from which I have drawn some interesting particulars. He has also permitted me to reproduce photographically several of the specimens supplied by him, and these can thus be contrasted as modern types with the older ones reproduced from the Linnean and Sloane herbaria.

To Professor Isaac Bayley Balfour my grateful acknowledgments are due for having sent me the entire set of *Gossypium* specimens in the Edinburgh Herbarium—a collection rich in Indian cottons, one example of which, from Dr. Buchanan Hamilton's herbarium, I have reproduced. But no less am I indebted to Professor Albert Charles Seward, of Cambridge, for having forwarded to me a most instructive collection in the possession of that University. This contains, among other treasures, the actual specimen collected by Charles Darwin at the Galapagos Islands which has enabled me to rescue one obscure species and to establish I trust beyond doubt the existence of two distinct wild forms as met with in these Islands.

To Captain A. T. Gage, I.M.S., Superintendent of the Royal Botanic Gardens, Calcutta, my thanks are due for having sent, on inspection, a large selection of the specimens in that herbarium;

so also to Mr. W. Lawrence Balls, of the Khedivial Agricultural Society, Cairo, for having prepared for me an interesting collection of the cottons at present being specially grown and hybridised in Egypt. To Mr. Isaac Henry Burkill, my successor as Reporter on Economic Products to the Government of India, I am also under obligation, more especially for having sent me a complete duplicate set of all the collections in the herbarium belonging to that office, not a few of which had been procured by myself, and which bore notes and descriptions which otherwise I might have overlooked.

Mr. John S. Slater, who for some time past has been giving attention to the subject of pollen-grains, has investigated those met with in an extensive series of species, varieties, and races of *Gossypium*, furnished by me for that purpose. His results have been dealt with very briefly, but it is believed the subject will be found of considerable interest and value, in the light of a possible aid to the study of hybrids generally and the hybridisation of the cottons in particular. I am thus under no small obligation to Mr. Slater for his kind collaboration.

I am much indebted to my niece Miss L. Hall, for having verified the references, and prepared under my instructions the Appendix and Index. It will be found that the Appendix consists of three lists: 'A' an enumeration of the specimens examined by me assorted in alphabetical sequence of the names of the collectors; 'B' the bibliography of cotton—an assortment of books, reports, periodicals, in sequence of authors' names; and 'C' the synonymy of the species of *Gossypium*. The Index, therefore, gives the references to subjects not shown under 'A,' 'B,' and 'C' of the Appendix.

To Messrs. Longmans, Green & Co., my thanks are in a special degree due for not only having devoted the time and care necessary for the publication of a more or less technical work, but for having generously allowed me to illustrate it with the completeness that alone can insure success. The illustrations are of four kinds: (*a*) reproductions by the three-colour process of photography (half natural size); (*b*) photographs of herbarium specimens, mostly the types of the species concerned (the scale in each case being indicated); (*c*) original drawings made by Miss M. Smith, from dried specimens (approximately life size, the dissections being usually enlarged); (*d*) micro-photographs of pollen-grains. Two of Miss Smith's

drawings have been reproduced in colour and half life size: namely, Plates nn. 30 and 48. I take this opportunity to acknowledge the untiring efforts of Miss Smith to secure accuracy in detail combined with artistic delineation. In this connection also I may explain that the photographs of types given have been made from dried botanical specimens, collected many years (or even centuries) ago, some of which are, unfortunately, not in the best state of preservation, and moreover were dried and mounted long before it was realised what should constitute a botanical specimen. In some cases the types are glued on to sheets of paper or pages of books, in others held in position by narrow bands of silk gummed across them **(see Plates 36, 37, 38, and 39)**. It is, however, believed that the reproduction of the authentic types of the species of *Gossypium* may prove of value to botanists, planters, and seed-producers throughout the world.

GEORGE WATT.

Kew Gardens,
July 1907.

CONTENTS

CHAP.		PAGE
	INTRODUCTION	1
I.	HISTORY OF COTTON AND THE COTTON INDUSTRY .	9
II.	THE COTTON FIBRE	25
III.	THE SPECIES, VARIETIES AND RACES OF THE COTTON PLANT	52
IV.	IMPROVEMENT OF THE COTTON PLANT. . . .	319
	APPENDIX: (A) Enumeration of Specimens examined: (B) List of Works consulted: and (C) Synonyms of Species, Varieties, &c.	353
	INDEX	385

ILLUSTRATIONS

Nos.			
1.	Gossypium vitifolium, *Lamk.*	*Frontispiece*	
2.	Gossypium Sturtii, *F.v.M.*	*to face p.*	63
3.	Gossypium Davidsonii, *Kellog.*	„	65
4.	Gossypium Darwinii, *Watt.*	„	68
5.	Gossypium tomentosum, *Nutt.*	„	70
6.	Gossypium Stocksii, *M. Mast.*	„	74
7.	Gossypium arboreum, *Linn.*	„	81
8.	Gossypium arboreum, *Linn.*	„	82
9.	Gossypium arboreum, *Linn.*, var. sanguinea, *Watt.*	„	92
10.	Gossypium arboreum, *Linn.*, var. neglecta, *Watt.*	„	95
11.	Gossypium arboreum, *Linn.*, var. neglecta, *Watt.*	„	97
12.	Gossypium arboreum, *Linn.*, var. (Dacca Cotton)	„	103
13.	Gossypium arboreum, *Linn.*, var. assamica, *Watt*	„	108
14.	Gossypium arboreum, *Linn.*, var. rosea, *Watt.*	„	112
15.	Gossypium Nanking, *Meyen*	„	115
16.	Gossypium Nanking, *Meyen*, var. himalayana, *Watt.*	„	124
17.	Gossypium Nanking, *Meyen*, var. rubicunda, *Watt.*	„	126
18.	Gossypium Nanking, *Meyen*, var. rubicunda, *Watt.*	„	127
19.	Gossypium obtusifolium, *Roxb.*	„	139
20.	Gossypium obtusifolium, *Roxb.*	„	141
21.	Gossypium obtusifolium, *Roxb.*, var. Wightiana, *Watt.*	„	144
22.	Gossypium obtusifolium, *Roxb.*, var. Wightiana, *Watt.*	„	150
23.	Gossypium obtusifolium, *Roxb.*, var. africana, *Watt.*	„	154
24.	Gossypium herbaceum, *Linn.*	„	157

25. Gossypium herbaceum, *Linn.* . . . . . *to face p.* 158
26. Gossypium mustelinum, *Miers Ms.* . . . „ 167
27. Gossypium punctatum, *Sch. et Thon.* . . . „ 169
28. Gossypium punctatum, *Sch. et Thon.* . . . „ 170
29. Gossypium hirsutum, *Linn.* . . . . . „ 184
30. Gossypium hirsutum, *Linn.* . . . . . „ 186
31. Gossypium hirsutum, *Linn.* . . . . . „ 194
32. Gossypium hirsutum, *Linn.*, var. religiosa, *Watt.* „ 200
33. Gossypium hirsutum, *Linn.*, var. religiosa, *Watt.* „ 202
34. Gossypium Palmerii, *Watt.* . . . . . „ 204
35. Gossypium Schottii, *Watt.* . . . . . „ 206
36. Gossypium microcarpum, *Tod.* . . . . . „ 210
37. Gossypium peruvianum, *Cav.* . . . . . „ 214
38. Gossypium peruvianum, *Cav.*. . . . . „ 216
39. Gossypium mexicanum, *Tod.* . . . . . „ 226
40. Gossypium mexicanum, *Tod.* . . . . . „ 229
41. Gossypium mexicanum, *Tod.* . . . . . „ 231
42. Gossypium mexicanum, *Tod.* . . . . . „ 236
43. Gossypium taitense, *Parl.* . . . . . „ 248
44. Gossypium purpurascens, *Poir.* . . . . . „ 250
45. Gossypium vitifolium, *Lamk.* . . . . . „ 256
46. Gossypium barbadense, *Linn.* . . . . . „ 266
47. Gossypium barbadense, *Linn.*, var. maritima, *Watt.* . . . . . „ 268
48. Gossypium barbadense, *Linn.*, var. maritima, *Watt.* . . . . . „ 276
49. Gossypium brasiliense, *Macf.* . . . . . „ 296
50. Gossypium brasiliense, *Macf.* . . . . . „ 298
51. Gossypium Kirkii, *M. Mast.* . . . . . „ 316
52. Characteristic Pollen Grains of Wild and Cultivated Species of Gossypium . . . „ 346
53. Characteristic Pollen Grains of Wild and Cultivated Species of Gossypium . . . „ 348

WILD AND CULTIVATED COTTON PLANTS

INTRODUCTION

Scope of the Work.—This account of 'The Wild and Cultivated Cotton Plants of the World' has been written on the basis of the species of *Gossypium* as they can be accepted botanically, but with the distinct object of aiding cultivation.

During a residence in India of some thirty years I had many opportunities of studying the subject practically. As Reporter on Economic Products to the Government of India it became, moreover, my official duty to travel over that vast country, from one end to the other, and, while moving from village to village, to study practically the resources of the Empire. A fair proportion of my time was not unnaturally devoted to the subject of cotton, and my collections and notes soon became voluminous. But as that study advanced from year to year I found many occasions not only to arrive at conclusions opposed to those held by some of my predecessors, but to modify or abandon views previously entertained, and even published, by myself. I mention these particulars as disposing once and for all of any change of ground that may be detected, but more especially with a view to exemplify the extreme complexity of the task of solving the varieties, races, and hybrids of a plant so much cultivated as cotton. Let me hasten, therefore, to add that I cannot hope to have even now attained finality; but shall be abundantly satisfied if I have succeeded in throwing out suggestions that may tend to elucidate practical results, both commercially and botanically.

It need hardly be here stated that cotton has been cultivated from prehistoric times, and accordingly that the origins of some of the chief commercial stocks can be but conjecturally ascertained. Moreover, cotton cultivation originated and is pursued within the

tropics (or, rather, within a belt of the earth's surface that stretches round the globe, between the extremes of 45° north and 30° south latitude) and at several distinct and independent centres. For example, we have abundant evidence that a knowledge of the plant and its industrial possibilities is quite as ancient in the New as in the Old World. This idea of independent centres obviously involves the utilisation of indigenous and presumably distinct plants, and hence the undesirability of accepting the dictum that the existing cultivated races are but states of one species. But if evolved from several centres and several species, certain questions naturally are forced into prominence :—

Important inquiries.

1. What were the centres and species of first cultivation?

2. Do any of these early cultivated plants exist as wild species to-day?

3. By whom were they first cultivated?

4. With what climatic and soil conditions are they accordingly specially associated?

5. What are the necessities and conditions that have caused their peculiar modifications?

6. Are the species and varieties of the cottons of commerce modified through the selection and perpetuation of variations and sports, due to an inherent tendency to change under altered environment?

7. If they are simply sports, can it be shown that for each original centre there exists a well-defined assemblage of its own?

8. To what extent, if any, have they been modified by being crossed (hybridised) the one with the other?

9. Can it be shown that the special features of merit in any particular staple are traceable to this or that specific ancestor or ancestors in the supposed hybrid stock?

These and other such questions can easily be framed. I do not categorically answer any of them. In fact, the possibility of their being definitely answered has been very nearly effaced by the lapse of ages. I have engaged, however, in an analytical study of every aspect of the cotton problem that seemed to me calculated to throw light on these and such-like subjects of inquiry.

Haphazard opinions.

Uniformity in Names.—To the practical cotton-grower I would urge that the writings of botanists should not be regarded as necessarily devoid of practical value. The selection and improvement of stock can never be successfully accomplished when based on haphazard opinions and observations. Ignorant experiment is the

lavish expenditure of money and time on the off-chance of a happy accident. It is a lottery in which the chances are against the adventurer. One might instance numerous failures, in almost every cotton-growing country in the world, due primarily to neglect of the first principles that should guide operations. Highly-paid administrative officials—Cotton Commissioners—have been (and are still being) placed in charge of what must of necessity be scientific and expert investigations. Vexatious legislation, lavish expenditure of money, the publication of unscientific and useless reports, disappointment and failure are the not unnatural consequences. This is the record of practically every country, except perhaps the United States of America. And success even in the States has, until quite recently, been due to two circumstances—the intelligent cultivation of colonists and the highly suitable environment of the country of their adoption. Recently, however, scientific selection and improvement of stock has begun to place the industry of the States on a safer foundation, and in consequence the publications of the Bureau of Plant Industry have for some years past been replete with practical results.

Scientific selection.

To work intelligently, it is essential that some conception of the botany of the plant intended to be operated on should, in every instance, be made the basis of the experiments conducted. I have accordingly endeavoured to exhibit, all through my botanical dissertations, the practical bearings of importance. A collective statement of cotton cultivation—the methods pursued and the results obtained in the world—would be quite meaningless if made regardless of the species or races of plants grown and of the countries of production, more especially the climatic conditions that there prevail. It is on this account that I have dispersed such details as I have thought desirable to furnish under the names of the species concerned.

To the botanist I would say that a serious error has run through practically all that has been written on *Gossypium*. The species first made known were cultivated plants. These were named by Linnæus as a result of the correlation of the publications of his predecessors, on the basis of his binominal system. Since then it has far too often been assumed that no wild species of *Gossypium* existed anywhere, and accordingly, as specimens of such were discovered here and there, they were named, on the standards of the five or six Linnæan types, the assumption being apparently accepted that there could be no other species.

Names of cultivated plants.

Anomalous genus.

We have thus the anomaly of a genus of plants never seriously dealt with by any botanist. In fact, subsequent to Linnæus, several authors have proposed the reduction of all to one species; others to three (one for the black-seeded, a second the white-seeded, and the third the red-seeded cottons); and still others have gone to the opposite extreme and needlessly multiplied the species by making the cultivated states seen by them, or mentioned by previous writers, each and all separate and distinct species.

Revision Essential.—Perhaps no stronger justification for a revision of the cultivated and wild species of *Gossypium* could be given than that made by Seemann ('Fl. Vit.' 1865, p. 21). 'The genus *Gossypium* is in great want of a thorough revision. At present, great doubt prevails as to the number of species composing it. Bentham and Hooker ('Gen. Pl.' i. p. 209) express the belief that only three species exist, including even the Australian *Sturtia*, whilst Todaro, of Palermo, enumerates thirty-four. I believe that if all the characters are carefully noted, a monographer will have no difficulty in defining a considerable number of well-marked species. The native country of many species remains also to be traced.' In the 'Journal of Botany' (iv., 1866, p. 269) Seemann adds: 'We do not hold *Gossypium* to be so difficult a genus as it is generally represented to be.' Speaking of Todaro, it may be added that his final work ('Relazione sulla Cult. dei Cotoni,' 1877–78) describes fifty-four species with, under many of these, several varieties. As to the genus not being a difficult one, the opinion held by M. Alph. de Candolle ('Origin of Cult. Plants,' Fr. ed. 1883, p. 328) may be here shown: 'Where there is such confusion it would be the best course for botanists to seek with care the *Gossypia* which are wild in America, to constitute the one or more species solely upon these, leaving to the cultivated species their strange and often absurd and misleading names. I state this opinion because with regard to no other genus of cultivated plants have I felt so strongly that natural history should be based upon natural facts, and not upon artificial products of cultivation.'

Number of species.

Confusion.

One exception only can be taken to that view—namely, the suggestion of restricting search for wild species to America. There can be no manner of doubt that the Old World possesses to-day very possibly quite as many and as valuable a series of wild cottons as have as yet been recorded from the New.

In almost every large herbarium there is likely to be discovered

one or more cottons, recorded by the collectors as wild species; these, it will be further discovered, have been utterly neglected by botanists and have received no names other than those suggestive of their supposed identity with Linnæan forms. Wild forms.

Priority in Names.—The reckless way in which scientific names have been employed by writers on cotton has, in many directions, greatly retarded practical results. Obviously it is of prime importance to know that the *G. arboreum* or the *G. herbaceum* of writers who report useful practical results, attained in their cultural experiments, are the identical same plants as accepted by others who contemplate similar investigations. There is only one safe course to follow in securing this uniformity—namely, the rigorous adherence to the botanical rule of priority. Uniformity in names.

It is imperative, therefore, to ascertain who first used each name and to discover, if that be possible, the actual specimen (the type) to which he restricted it. There can be no departure from this rule, otherwise nothing but chaos can result. With cultivated plants that very often differ structurally but little from each other, yet are industrially widely distinct products, it becomes essential that the matching with types should be close and careful. This is no matter of botanical etiquette, but is vital to success in all crop improvements that are dependent on selection and crossing.

While that is so, it would almost seem as if it had been held by some writers that they had a perfect right to pick and choose among the names in current use for cottons, and thus to employ what amounts to a jargon of high-sounding words which have no meaning to anyone else than themselves. As already observed, the species have doubtless been often needlessly multiplied, but some authors would seem to have thought that, like nine-pins, they had been set up purposely to be knocked down again, and then transposed to altogether different plants. There can, for example, be nothing gained by making the name *G. obtusifolium, Roxb.*, denote a species under which to place, as sub-species, the plants separated by Linnæus under the names *G. arboreum* and *G. herbaceum*, yet this has been seriously proposed by a recent writer on Indian cottons.

Specific Types.—I have, it will be observed, made the study of the types of each species my first concern, and to help others to form their own conclusions as to the accuracy or otherwise of my determinations I have photographed and reproduced the original types, or, where that was impossible, have photographed specimens Types photographed.

so named by the earliest trustworthy authors. Where thought desirable, also, I have reproduced the first or most generally accepted picture of each species. Having thus made up my mind as to the species that exist, I have next endeavoured to weigh carefully all that might be said in favour of or against certain forms being retained as distinct or reduced to older species (synonyms). But in doing so I have generally followed the rule that, wherever possible, it was preferable to retain as a species a recognisable form, rather than to reduce it to the position of a sub-species or variety. I have in fact viewed a variety of cotton as a form that might, with an extensive assortment of specimens, be found inseparable from the species with which it was associated. This view becomes essential when cultivation is realised as having so interrelated a large percentage of the forms, that we are confronted very nearly with the necessity of either reducing all to one species or accepting many species.

Synonyms.

Wild Species.—The existence of numerous undoubted wild forms (some of which have never been recorded as met with under cultivation) renders the latter course unavoidable. I have accordingly retained as species very nearly all the plants found either wild or in a state of complete acclimatisation, especially when the nature of the flosses afforded was such as to justify the belief that these plants possibly manifested a close approximation to the original specific condition. Where such wild plants have at any time been treated as species by authors, I have selected the earliest name for each and retained that to denote the wild condition, even although the cultivated states might with difficulty be separable from it. This course seemed desirable as a basis from which to study the races of cultivated cottons, and thus, as De Candolle recommended, I have gone back to the wild (or presumably wild) plants and retained the majority of the names given by Linnæus and his predecessors, as the names chiefly of cultivated stocks. And in support of this it may be observed, there would seem hardly any doubt, that no truly wild cotton was discovered and named before the close of the first decades of the nineteenth century. Accordingly all the names given by botanists to species of *Gossypium*, prior to that period, almost of necessity denote cultivated forms.

Undoubted wild species.

Cultivated races.

I have not, however, named every wild *Gossypium* seen by me, but rather have limited myself to those likely to have a practical bearing on the larger issues, or to those of which sufficient material

existed to allow of fairly satisfactory descriptions being framed. Similarly I have not attempted to solve the enigma of every species that has been formed by authors who, in many cases, seem to have treated accidental states as distinct forms or new species. The citation of synonyms, given by me, has been accordingly largely restricted to those that could be advanced with some degree of assurance or to instances where historically it seemed desirable that some attempt should be made to determine the probable plants indicated.

Enigma of names.

It will, moreover, be observed that I have proposed to classify the wild cottons on a system that I trust may be found to bear comparison with that pursued in other genera. From that position I have advanced to the inclusion of the cultivated forms within the sections established for their presumed wild allies. But a still further step has been taken, by the effort having been put forth to classify the cultivated varieties, races, and hybrids of the various species, so far as the material at my disposal would admit of such being attempted. Under most of the recognisable races I have furnished comparative descriptions, that may not only allow of their identification, but afford data to mark the progression or retrogression of future cultivation.

Classification.

Fully a century ago Rohr urged (as a result of many years' study of the living plants in the West Indies) that trustworthy specific characters could not be based on the shape of the leaf, the number and position of the glands, or the peculiarities of the bracteoles. He accordingly thought that the only satisfactory classification was to be founded on the conditions of the seed. While I have accepted that suggestion, and I trust made my studies of the seed yield features of considerable utility, I have rested my classification upon an assemblage of structural peculiarities rather than upon any single characteristic by itself. Had Rohr lived to-day he would doubtless have founded *his* classification on the manifestations of the wild species. He would thus have escaped from the complexity and confliction that he fell into through dealing with but one aspect of the cultivated cottons.

Characters of the seed.

Characteristics of Wild Cottons.—It may not be out of place to mention here a few of the features of the wild cottons. They all have, for example, a red-coloured woolly coating on the testa of the seed. In some this assumes the condition of a short dense velvet, called the *fuzz*. In others there are two coats of wool—an under-

Red-coloured wool.

Fuzz and floss.

fleece (the fuzz) and an outer coat, the wool proper or *floss*. In still a third there is no fuzz, but a distinct floss. Of the first series, so far as my knowledge goes, there are no cultivated examples. Of the second, the fuzzy-seeded cottons, as a rule, necessitate the use of saw-gins before the floss can be torn from the seed. Of the third, the floss separates readily, and the seed is then spoken of as naked. (Cf. p. 27.)

These peculiarities are, I believe, almost sub-generic in value, and there exist several purely wild cottons of each assemblage, as well as many cultivated representatives.

Cultivated white floss.

Characteristics of the Cultivated Cottons.—The first and most convenient eye-mark of cultivation is accordingly the production of a long white floss in both the fuzzy-seeded and naked-seeded forms. Next, the mixing of both these properties, a result which, so far as I can discover, can alone have been attained by crossing or hybridising. It is unknown in the wild state. This view, moreover, receives much confirmation by geographical considerations. Wild naked-seeded forms rarely exist in countries that possess wild fuzzy-seeded species. The sporting or rather variability of a fuzzy-seeded into a naked-seeded form, or *vice versa*, becomes accordingly an almost certain proof of hybridisation—is of necessity a case of 'reversion.'

These are facts which it will be found I elaborate and emphasise again and again, because they seem to me to demand careful consideration. Ignorance of their value has been the stumbling-block of many past investigators, due directly to having omitted to study the wild species before they attempted to master the cultivated ones.

CHAPTER I

HISTORY OF COTTON AND THE COTTON INDUSTRY

It would not be far from correct to describe Cotton as the central feature of the world's modern commerce. Certainly no more remarkable example of a sudden development exists in the history of economic products than is the case with cotton. The enormous importance of the textile to-day, in the agricultural, commercial, industrial and social life of the world, renders it difficult to believe that, but little more than two hundred years ago, cotton was practically unknown to the civilised nations of the West. But it is perhaps even still more singular that a fibre which, for many centuries apparently, had been a staple article of clothing in India and the East generally, should scarcely find a place in the early classic literature of these countries. Nearly all the beautiful and useful plants of India have their properties extolled by the Sanskrit poets, and indeed are frequently dedicated to the gods, but cotton—the plant above all others which might have been expected to have formed the theme of nature worship—is hardly more than incidentally mentioned.

Unknown two centuries ago.

The Sanskrit word *kárpásá-i*, usually rendered 'cotton,' is connected with the Greek and Latin *karpasos* and *carbasus*, but meant originally Spanish flax. It was also known to the Phœnicians and Hebrews, but whether it originated in India or was imported would be hard to say. Mr. F. W. Thomas, who has kindly permitted me to consult him on this point, informs me that 'the earliest mention appears to be in the Ásvaláyana Srauta Sútra (say 800 B.C.), where the material is contrasted with silk and hemp as that of which was made the sacred thread of the Brahman. Probably the word was borrowed from India. The other words *túla* and *picu* are later—they denote the substance.'

Sanskrit names.

'The Sanskrit dictionaries give four names (*vadara*, *kárpási*, *tundikeri* and *samudránta*) for the shrub, while the wild kind is called *bháradváji*. They also mention that *kárpása* and *vadara* (the

Library

material) come from the fruit of the plants in question, while the Harsacarita (circa 650 A.D.) twice speaks of the cotton (*tûla*) from the pods of the *sâlmali* (*e.g., Semul, Bombax malabaricum*) tree.'

In the Institutes of Manu injunctions exist that regulate the operations of the washermen and of the weavers; these all point to a social organisation and industrial attainment in which a knowledge of cotton is essential, but it is taken for granted rather than expounded or justified. All this might of course argue antiquity, as it certainly does for the arts of spinning and weaving, but the word *kârpási* may have existed for centuries with a generic rather than a specific signification.

Other Classic names.

Similarly, it is extremely difficult, if not impossible, to determine the earliest certain references to cotton in the Persian, Arabic and European classics. It is fairly clear that *qutn* (*katán* or *kutun*), its Arabic name, from which we have derived the English word 'cotton,' originally denoted flax, not cotton. So also in Greek *karpasos*, often rendered 'cotton,' had the still earlier meaning of flax, or simply of a fine textile. The word *linon* (flax) was itself at one time used to denote cotton, and to-day it is customary to speak of the cotton floss as being 'lint.' With all these and many other such contradictions it is not difficult to concur with Yates ('Textrinum Antiquorum') that the poets assumed a licence in the use of the word *carbasus*. That being so, the greatest possible caution is necessary. But there would appear to be no doubt that cotton textiles had been carried to Europe, and were regularly traded in, long before any definite knowledge existed regarding the plant or the fibre of which they were made. In fact the Greeks were first acquainted with the cotton plant through the group of explorers who accompanied Alexander the Great and his immediate successors in India.

Greek discoveries.

Herodotus (450 B.C.), it is true, speaks of India having *wild trees* that bear fleeces (*eiria*) as their fruits. But right down to the middle of the eighteenth century the wool-bearing trees were divided into those with spinose and those with smooth stems. The former were the silk-cotton trees, of which *Bombax malabaricum*—the *Sálmali* of the Sanskrit authors—may be given as the type, while under the latter many of the early botanical writers included *kapok—Eriodendron anfractuosum*. A very large percentage of the writers of the period indicated speak of cotton being used for quilts and mattresses, but are silent regarding its being spun and woven.

Quilting cottons.

Ktesias would appear to have been the first European who

observed the spinning and weaving of the Natives of India, but his description does not necessarily denote cotton as the fibre employed.

First description of Indian cotton.

Theophrastus (350 B.C.) gives us the first definite conception of Indian cotton cultivation. He says ('Hist. Pl.' IV., c. 4, p. 132, ed. Schneider), 'The trees from which the Indians make cloths have a leaf like that of the mulberry; but the whole plant resembles the dog-rose. They set them in the plains arranged in rows, so as to look like vines at a distance.' So again in a further passage he speaks of the island of Tylos as containing many wool-bearing *trees* which have a leaf like that of the vine but smaller, from the fruits of which they obtain wool which they weave into textiles, some cheap, others of great value. He then adds that cotton cultivation may be seen both in India and Arabia.

Cultivation.

The expressions used by Theophrastus would seem to suggest that the plant of Tylos was different from that of India. The comparison, for example, to the mulberry would suit *G. herbaceum* or its allied Indian form *G. obtusifolium*, while the comparison to the vine might be viewed as indicative of *G. Nanking*. The reference to the Indian plants as set in rows involves cultivation of course, but it would be equally applicable to the perennial as to the annual plant. The comparison to the dog-rose, with its open branches, however, brings to mind the perennial *G. Nanking*, more especially the *roji* plant of India, rather than the small compact bush of the ordinary annual cotton.

Garments of Natives.

Nearchus describes the 'linen' garments of the Natives of India as woven of the fleeces of trees, and he also discusses the appliances used by them in separating the wool from the seed. Arrian, Strabo, and other early Greek authors employ the word 'linen' (and synonymously *karpasos*) to denote a fine textile. The more correct Indian signification of *carpasus* (cotton) was upheld, however, by many writers. *Kirbas* (or *karpas*) occurs in the Hebrew Scriptures (Esther, I. 6): the green hangings at the palace of Susa. In the Augustan age of Latin authors curtains and tents of *carbasa* were frequently mentioned. Pliny (Bk. XII. ch. 21) tells us that cotton (*carbasa*) was in Tylos called *Gossympines*. He does not state whence he derived that information, but curiously enough, by modern botanical writers, that word seems to have originated the generic name for the cottons (*Gossypium*). *Ambrosinus* ('Phyt.' 1666, I. 106) renders it as *Cossipium* (the fleece worm), hence *Gausapium* and *Gossampine* cloth. (Cf. p. 59.

First definite account of Indian cotton trade.

In the 'Periplus of the Erythræan Sea' (63 A.D.) we have the first commercial mention of Indian cotton. The raw fibre, as also the Indian cotton manufactures, were, we learn, conveyed by the Arabs from 'Patiala, Ariake and Barygaza' (the modern Broach) up the Red Sea to 'Aduli.' Masulia (the modern Masulipatam) was even then famous for its painted calicos, and the fine cotton cloths (muslins) called by the Greeks *gangitiki* came very possibly from Dacca.

The 'Indika' of Arrian, a work compiled (150 A.D.) from Nearchus, Megasthenes, Strabo and Eratosthenes, as also other early Greek travellers, was professedly intended to supersede the inaccurate account of India given by Ktesias of Knidos. After narrating the particulars above mentioned, Arrian adds that the cotton of India is whiter and brighter than that of any other country. Thus by the beginning of the Christian Era we have a fairly vivid glimpse of India as a cotton-growing and cotton-manufacturing country.

Confusion in names.

The simple reference to a fibre or textile under such names as *kárpási*, *quin*, *linon*, *carbasa*, *xylon* or *gossypion*, may, however, be of no historic value. It has to be shown that the word used had the same signification as to-day. And in the case of cotton, a description of wool obtained from pods would not in itself be conclusive of *Gossypium*, since it would be equally applicable to *Bombax*, *Eriodendron*, *Calotropis*, &c. Moreover, there would seem no doubt that certain ancient words that denoted 'woolly' or 'silky' and the like were each adopted by comparatively recent writers for certain fibres, in order to distinguish the chief textiles as they came into use. Writers of a still later date traced out the antiquity of these words and claimed that antiquity for the fibres that now bear the names (or synonyms) in question. Many illustrations might in fact be given of the confusion that prevailed regarding the separate recognition of the chief textiles of the world down even to the seventeenth century. At Manchester, for example, a particular texture of goods, *woven of wool*, was in 1590 sold under the name of 'Manchester Cottons,' the name being intended to denote quality, not material. In 1664 the dispute between Sir Martin Noel and the East India Company as to whether 'calico was linen or no' became acute, and that controversy shows how very reluctantly the name 'cotton' was, in England even, accepted as indicative of a distinct fibre.

Coining of names.

Arab authors.

There is, however, every reason for believing that the Arabs knew of cotton and wore cotton garments before the present era.

Unhappily no writer can be discovered who effectually bridges over the gap between the period of the 'Periplus' and that of the physicians and poets who wrote in the sixth to the tenth centuries. Serapion—an Arab medical writer (who lived about 850 A.D.)—quotes several earlier Arab authors, among whom Ibn Hanifa, he says (speaking of Kelbe), described the cotton as growing there on trees which live for twenty years, but attain their best bearing condition about the ninth year. Arabian perennial cottons.

Abbé Renaudot gives a translation of the journal of an Arab (Sulaimán) who visited China and India, and his diary bears the date of 851 A.D. An annotated version of this work (916 A.D.) was prepared by Abú Zaidu-l Hasan of Síráf, who confesses to have derived much of the additional information from Mas'údí and other travellers. The oldest known MS. of Sulaimán with Abú Zaid's annotations bears the date of 1173, and was translated in 1718 by Renaudot (with an English translation in 1733) and again into French in 1845 by M. Reinaud. Speaking of the town of Calicut, Sulaimán says the 'garments are made in so extraordinary a manner that nowhere else are the like to be seen. These garments are for the most part round, and wove to that degree of fineness that they may be drawn through a ring of middling size.' Calicut, in 9th century.

Sulaimán makes special mention of the fact that the Chinese, rich and poor, were seen to be dressed in silk, but he says nothing of cotton in China. It is one of the many surprises met with everywhere in the study of the world's production and trade in cotton that the plant was not regularly cultivated in China for its fibre until about the thirteenth century. In the sixth century we read of the Emperor Ou-ti having possessed a robe of cotton that he held in much esteem. Towards the end of the seventh century the plant was an ornamental shrub in Chinese gardens. Mayers tells us that it was not until about 1000 A.D. that the plant was fully introduced into China, and Bretschneider says cultivation began in the eleventh century ('Bot. Sinicum,' I. 119). There was apparently in China (as in Europe) considerable opposition to the introduction of cotton, but to-day the poor of that country are as much clad in cotton as are the Natives of India, Africa, or Arabia. China, in 11th century.

Marco Polo (who travelled through a large portion of Asia in 1290 A.D.) refers to the production and manufacture of cotton in Persia, Kashgar, Yarkand, Khotan, Guzerat, Cambay, Telingana, Malabar, Bengal, &c., but is absolutely silent on these subjects in connection with China. Speaking of Gujarat he says the cotton Indian perennial, in 13th century.

trees are of great size and attain an age of twenty years, but he adds when of that age the cotton is only used to quilt or stuff beds.

Abyssinian cotton.

Referring doubtless to Masulipatam, he says it produces specially fine 'buckrams' (muslins) and chintzes. Lastly he tells us that both Socotra and Albash (Abyssinia) possess much cotton and manufacture fine buckrams.

Tree cottons of Gujarat.

Rashiduddin (Jámiu-t Tawarikh, 1310 A.D.), who compiled largely from Al Biruni (who lived 970 to 1039), speaks of the cotton plants of Gujarat growing like willows and plane trees, and yielding produce ten years running.

Ralph Fitch, who travelled in India in 1583, speaks of the finest cotton cloth being made at 'Sinnergan,' while Abul Fazil, about the same time, mentions the cotton cloth named *cassas* as made at 'Soonergong.'

Mir Muhammad Masum, of Bhakkar, in his 'History of Sind,' written 1600 A.D., speaks of the cotton plants growing as large as trees, and says that men pick the wool mounted.

The Rev. E. Terry, chaplain to Sir Thomas Roe's Embassy to India in 1615, mentions the cotton plants near Surat as growing for three or four years before being uprooted.

Della Valle ('Travels in India,' 1623) comments on the Surat linen as being altogether of 'bumbast' or cotton. The cotton plant seen by Rheede in Malabar during 1686 he describes as a shrub, 10 to 12 feet in height, found growing in sandy places—he does not say cultivated.

Cotton in Egypt.

Turning now and very briefly to Egypt. Pliny, in his account of Æthiopia, speaks of the portion that borders on Egypt having cotton plants that afford a more woolly fibre than is customary, and as possessing exceptionally large pods. Yates ('Textr. Antiq.'), commenting on that passage, observes that the plant referred to may have been *G. arboreum*. He further says that cotton was not grown in Egypt proper during ancient times. In support of that view he affirms that the MS. copies of both Pliny and Julius Pollux (a century later than Pliny), that have been cited as upholding an ancient cultivation, have had that interpretation put upon them through marginal annotations, made about the fourteenth century A.D., being taken as parts of the original text. He accordingly maintains that cotton was first cultivated in Egypt about the thirteenth or fourteenth centuries, and, in support of that opinion, mentions the fact that the Arab physician Abdullatiph, who visited Egypt in

1200 A.D., and published a list of the plants he saw, makes no mention of cotton. And this view is confirmed by Prosper Alpinus ('De Pl. Æg.'), who makes the significant observation that the Egyptians in 1592 imported cotton for their own use from Syria and Cyprus, and only cultivated in their gardens, as a curious and ornamental plant, the *Gossypium* which he figured and described, viz. *G. arboreum*. He adds, however, that the Arabs make webs of that cotton, which they call *sessa*. (*Cf. with Rawlinson, Egypt*, I. *p.* 53; *M.C. Joret, Les Pl. dans l'Antiq.* 1897, *p.* 43).

Cotton imported in 16th century.

Forskal ('Fl. Æg. Arab.' (1775), p. 125) indicates two forms of cotton met with by him—*G. rubrum*, which he says is known to the Arabs as *Oth*, *hadiae* or *odjas*; from the description given, the plant indicated was very likely to have been *G. arboreum*, *Linn.*; while his second species (which *he* calls *G. arboreum*) answers fairly closely to *G. herbaceum*, *Linn.*—a view confirmed by the examination of his specimens, preserved in the British Museum. (In this connection conf. with Adler and Casanowicz, 'Biblical Antiq.' in Ann. Rept. Smithsonian Inst., 1896, p. 1005.)

Cotton in Arabia.

It is thus very remarkable that the accounts given by the earlier authors, regarding Indian and Egyptian cottons, almost all point to perennial, not annual plants.

Perennial *versus* Annual.

There are two great and apparently independent centres of annual cottons:—(*a*) the oriental—India and the *karpasi* of the Sanskrit authors; and (*b*) the occidental—Asia Minor and Arabia and the Arabic *qutn*, and possibly also the Coptic *kontion*. The Arabic *kirbas* probably denotes information or fabrics derived from India, and is thus perhaps indicative of the combined knowledge of the two centres.

In the ninth century Sicily was taken by the Saracens, and, according to Abu Zacaria Ebn el Awam (Banqueri's transl., II. ch. 22, p. 103), they at once introduced the cultivation of cotton. From the account given of the methods of cultivation, the plant must have been the annual stock now known as *G. herbaceum*.

Earliest indication of annual cotton.

In the tenth century the Muhammadans carried the self-same cotton plant (as I take it) across the Mediterranean to Spain, and for three centuries thereafter Barcelona had a flourishing cotton industry. There would thus seem no doubt the plant disseminated by the Muhammadans was *G. herbaceum*, the species presently cultivated in the regions indicated. Where they obtained that plant may be a matter of conjecture, but to-day the centre of its area of cultivation

Dissemination of *G. herbaceum*.

might almost be given as the northern tracts of Arabia and Mesopotamia, where it stands every chance of being indigenous. There is no doubt, however, that *G. herbaceum* was closely associated with the early Saracens; their religion, their cotton, and their sugar-cane might be spoken of as the triple agents of their civilisation. As a cultivated plant cotton was carried by them to Constantinople, and very possibly through Turkey, Asia Minor, Armenia, Kurdistan, and Mesopotamia to Khotan and Persia, if not even to the frontier of India. So also they in time may have conveyed it to Egypt, in connection with their Bagdad trade, which, on the conquest of Spain, went *via* Alexandria.

Its early cultivation in Europe.

But before passing away from this subject it may be added that there would seem no doubt that a limited cultivation of cotton had been established in Crimea and South Italy, some short time prior to the European conquests of the Saracens, so that it is just possible it may have existed, if it was not indigenous, in some of the islands of the Mediterranean (Cyprus for example) prior to the knowledge of its utilisation as a textile, just as the tea plant existed in Assam prior to its being brought from China by Gordon and Fortune. It is not surprising, therefore, that Dioscorides should make no mention of cotton, nor that Daubeny should have found no occasion to allude to it in his lectures (1857) on Roman husbandry. The cultivation of *G. herbaceum* in time, however, was diffused throughout the countries bordering both shores of the Mediterranean, and a cotton trade was established which held sway for several centuries.

Roman husbandry.

It may now serve the purpose of this brief historic review to compress into separate paragraphs, in sequence of occurrence, some of the chief historic facts that have a bearing on the world's cotton trade during the fifteenth, sixteenth, seventeenth, eighteenth, nineteenth, and twentieth centuries.

The Fifteenth Century.—A great intellectual movement took place all over Europe. The watch was invented; the art of printing organised; oil painting established; delf and glass-ware invented; America discovered, &c. The earliest mention of the English cotton trade appears to occur in a little poetic work entitled 'The Politie of Keeping the Sea.' This is given by Hakluyt in his 'Voyages,' &c. (vol. I. p. 213), and was apparently originally published in 1430. The merchants of Genoa are spoken of as carrying silk, pepper, woad, and cotton to England, and as taking back woollen goods. It is thus probable that, at an even earlier date than

English cotton trade.

indicated, England procured cotton (but most probably Indian manufactured goods mainly) from the Levant, since the name is mentioned as that of an ordinary commodity. Columbus discovered in 1492 the West Indies and America. The Spaniards, on their arrival in the New World, found cotton being cultivated and manufactured from the West Indies to Peru, and from Mexico to Brazil. In 1498 Vasco da Gama sailed for India round the Cape of Good Hope. The success of that expedition gave to Western Europe a direct route to India, and struck a severe blow at the commercial supremacy of Venice and Genoa. 'Thus, previous to the discovery of America and the West Indies, and for some time afterwards, England and probably all Europe were supplied with cotton from the Levant.' (Milburn, 'Or. Com.,' 1813, II. 279–82.)

Discovery of America.

The Sixteenth Century.—English colonies began to be established in North America. In 1516 Odoardo Barbosa found the inhabitants of South Africa growing cotton and wearing cotton garments. Down to the close of the sixteenth century England obtained her cotton (a small demand) from the Levant, and her supplies of Indian cotton goods *via* the Mediterranean ports. Cortez discovered (1519) that the inhabitants of Mexico possessed much knowledge and skill in cotton manufacture, and he sent an assortment of their goods to the King of Spain. (Clavigero, 'Hist. Mex.') As late as 1641 we read that 'the town of Manchester buys cotton-wool in London that comes first from Cyprus and Smyrna.' The supply, if any, from the West Indies must accordingly have been very insignificant. The early historians of Brazil (Beauchamp, De Souza, St. Hilaire, &c.) affirm that a cotton plant was found indigenous there and that the Natives made use of it to supply the cotton of their simple needs. In Bahia it must have been cultivated, however, since De Souza speaks of it (1570–87) as cleaned with the hoe, two or three times a year. Magellan (1519) found the people of Brazil using 'a vegetable down' in making their beds and in spinning thread, &c. Pizarro, in 1522, found cotton in Peru, and it has since been recognised in the ancient tombs of that country. De Vica is reported to have, in 1536, discovered a wild cotton in Texas and Louisiana. Similar reports have subsequently been spasmodically made, but no qualified botanist has critically studied the wild species of *Gossypium* that exist in the American Continent and Islands, and thus the stories of travellers have not been confirmed. When first made known to Europe, the American Continent

Africa.

Early English supply.

Mexico.

Brazil.

Peru.

United States: wild cotton.

Wild and cultivated cottons.

as also the West Indies, possessed not only a cotton industry but both wild and cultivated cottons, independent of those of the Old World. It is most unfortunate that no botanical specimens, no drawings, no descriptions exist of the plant or plants seen by Columbus and his associates. And, moreover, there is no record of these plants having been conveyed to Europe, so that we know nothing for certain of the species of American cottons until approximately two centuries after their original discovery. In fact we know more of the foreign stocks supplied to America than of the

African influence.

influences of its indigenous plants on the modern staple. By 1563 the slave trade was being vigorously carried on, and it is certain many African plants, and among these very possibly cottons, were conveyed to America. Cotton cloth woven on the coast of Guinea was, in 1590, imported into London.

The Seventeenth Century.—Vast intellectual progress was accomplished, as indicated by such names as Shakespeare, Milton, Dryden, Molière, Newton, &c. The first attempt to grow cotton in the

American cultivation.

United States was in Virginia. It was not, however, until the second decade of this century that systematic cultivation was

Levant seed in the U. S.

organised, and then from seed obtained both from the Levant and the West Indies. It took nearly a hundred years from that date before the plantations became of national importance, but the seat of the industry gradually shifted south and west. England began

England began to manufacture.

to be an important cotton-manufacturing country about 1635, and continued to draw on the Levant for her supplies of the raw fibre.

Indian goods.

Direct imports of Indian cotton goods were made by England in 1631, and the trade was largely participated in by the Dutch East India Company. An outcry against these imports was raised in England, and in 1678 a pamphlet was issued entitled 'Ancient Trades Decayed and Repaired Again,' the purport of which was a defence of the English woollen manufactures.

First authentic American cottons.

Marcgraf (who died in 1644) collected and described cotton in Brazil. His writings were published by Piso. He speaks of the cotton seen by him having the seeds united together—the condition we now call kidney-cotton. The plant indicated was cultivated in

Brazilian and Mexican.

Europe shortly after the date named, and Zanoni furnished an admirable picture of it. Hernandez ('Nov. Pl. Hist.' (1651), p. 308, and plate) found a cotton extremely common in Mexico, growing in warm, damp, cultivated places. He does not say wild, nor does he say cultivated. He gives a good plate of what is either *G. vitifolium*,

Lamk., or *G. mexicanum, Tod.*, and it is the earliest plate of an American cotton. According to Carroll ('Hist. S. Carol.') colonists from Barbados settled in America at Cape Fear about 1664, and brought cotton-seed with them. Samuel Wilson tells us that Smyrna and Cyprus seed, by the close of the century, had been successfully acclimatised in Carolina. In 1696 a pamphlet was issued in England entitled 'The Naked Truth, or an Essay upon Trade,' which bewailed the introduction of cotton into England.

Smyrna cotton in Carolina.

The Eighteenth Century.—Christianity proclaimed the brotherhood of mankind; engineering and manufacturing sciences and arts made immense progress. Daniel De Foe vigorously attacked the interference of the East India Company with the woollen trade of England. It can hardly be wondered at, therefore, that the eighteenth century should have opened with repressive legislation, passed by the British Parliament against Indian calicos; still the century witnessed the imports by England and Scotland of raw cotton amounting to 1,000,000 lbs. By an Act of 1720 the use and wear in England of printed, painted, or dyed calicos was prohibited. The prevailing evil of Indian calicos was attributed (in 1728) to the 'passion of the ladies for their fashion.' Peter Purry started cotton cultivation in Carolina in 1733. Cotton was raised in Georgia (in 1734) from seed supplied from Chelsea by Philip Miller (the original stock of the better grades of the green-seeded plant now known as *G. hirsutum*). In 1741 the first sample of Georgian cotton was sent to England. In 1739 we read of a Miss Lucas having been in charge of a plantation in South Carolina, and in 1748 the first consignment of this cotton was sent to England. In 1750 Lancashire had a population of 294,400, Liverpool had 34,000, and about the same time Manchester had 41,000. White Siam cotton is said to have been introduced into Louisiana in 1758. The French colonists of that State paid much attention to cotton, but, according to Du Prate, it was the 'Turkey kind' that they sowed. (Cf. p. 120.)

Repressive legislation.

Original stock of green-seed cotton supplied to the United States.

Siam cotton.

The mechanical achievements of Kay, Highs, Hargreaves, Arkwright, Wyatt, Cartwright, Compton, Bell, and Watt, by reducing the cost of manufacture and improving the quality of the textiles produced, enabled the British manufacturers to dispense with protective legislation. An Act of the British Parliament (Geo. III. c. 71) now prohibited the export of tools, utensils, machines, models, drawings, &c., used by the British cotton or linen manufacturers. The Assembly of the Province of Virginia recommended all persons

Virginian cotton.

who possessed suitable land to grow cotton, hemp, or flax. The following year (1776) the Declaration of Independence was proclaimed in the United States. In 1782 muslins were first made in England, and in that year South American or Brazilian cotton began to be regularly received. Two years later a ship brought fourteen bales of cotton from America to Liverpool, of which eight were seized on the ground that so much cotton could not have been produced in the United States. In 1784 cotton was grown in the States for the express purpose of being exported, and thus 150 years after the first attempts at introducing the cultivation. In 1786 the green-seeded cotton was, in the States, the most largely grown of all kinds, but in that year black-seeded cotton (very possibly *G. vitifolium*) was definitely mentioned as having been introduced from the Bahamas into Georgia, and two years later its cultivation was attempted by Mrs. Kinsey Burden in South Carolina. In 1790 Mr. Elliott, of Hilton Head, near Beaufort, procured seed from Charleston of a black-seeded cotton, presumably 'Sea Island,' and endeavoured to cultivate the same. Donnell ('Hist. Cotton,' 1872, p. 48) tells an interesting story which would seem to throw some light on the history of Sea Island cotton. It was raised from Pernambuco seed, sent from Jamaica by Patrick Walsh to his friend, Leavet, who removed to an island off the coast of Georgia, and there grew the seed with much success in 1789. The first regular exportation of cotton from Charleston was made in 1785, when one bag arrived in Liverpool, consigned to Messrs. John & Isaac Teasdale & Co.

Brazilian appeared in England before that of the States.

Green-seed plant largely grown.

Sea Island cotton sent to the States

Pernambuco cotton.

Dr. Hove was sent to India in 1787 to study the Indian cotton trade and Indian cotton plants, but his mission was resented by the East India Company, and his report was not published for sixty years after his return to England. Shortly after the date of Hove's visit, the East India Company commenced, however, a series of experiments with a view to improve the quality and increase the quantity of cotton produced in India.

Efforts made to improve Indian cotton.

Samuel Slater, an English mechanic from the cotton mills, emigrated to America possessed of sufficient knowledge to enable him to introduce into the States Arkwright's and the other English patents that had been hitherto so carefully guarded. English mobs destroyed in 1790 several cotton factories that were driven by steam or water power. Whitney's saw-gin was invented in America.

Up to this point, England obtained her supplies of raw cotton from the Levant, India, the West Indies, and South America, the

English supply and market.

finest qualities being spoken of as coming from Surinam and Cayenne. The century closed with the exports from the United States to England standing at 9,532,263 lbs., and from India at 729,643 lbs.

Cotton crop of United States.

The Nineteenth Century may be said to be mainly characterised by the advances made in the sciences. The century, moreover, opened with the cotton crop of the States being returned as 48,000,000 lbs., contributed as follows: South Carolina 20,000,000, Georgia 10,000,000, Virginia 5,000,000, North Carolina 4,000,000, and Tennessee 7,000,000 lbs. The exports from that crop to Great Britain were 20,000,000 lbs. Total consumption of raw cotton in Great Britain came to 54,000,000 lbs., the supply from India being 6,500,000 lbs., or just one-third of the quantity drawn from the new area—the United States of America. The first Indian cotton mill was built near Calcutta in 1818, and the first of the Bombay series in 1851. Improvements in bleaching, dyeing, and cylinder printing soon placed British calicos in a position to hold their own against similar goods from any part of the world. Resist printing was introduced by Sir Robert Peel. The duty on cotton imported by the East India Company from India and Turkey and by others from the United States and the British Colonies was fixed at 10*s.* per 100 lbs., and on the cotton from all other countries at 25*s.* per 100 lbs., but shortly after (1809) this law was amended to 16*s.* from all countries alike. The cotton-worm and other diseases of the plant began to give cause for anxiety.

First Indian cotton mill.

Calico-printing securely established.

Diseases of the cotton plant.

We now hear definitely of Sea Island cotton, and that raised at Hilton Head, South Carolina, is stated to have fetched the highest prices for cotton then known. Mexican cotton-seed was introduced into Mississippi by Walter Burling, and the existing plant was supposed thereby to have been improved very greatly, but whether by substitution of stock or by hybridisation has not been stated. Mention, so far as I can discover, has never been made of any one of the indigenous cottons of the States (if such existed) having been utilised by the colonists. They grew first Levant cotton, then Miller's green-seed cotton, then black-seed cotton, and, finally, what has been presumed to be Sea Island cotton. Which of these was improved by the Mexican has never been stated; presumably it was the green-seed, since it must have then been the prevalent form, but if so the Mexican plant was most probably *G. mexicanum*. Subsequent experience would, however, seem to point to a substitution of stock having more probably taken place, and in that case the

States cotton improved by Mexican

Levant and green-seed cotton.

introduced plant was most likely to have been *G. vitifolium*. Although we read, in 1664, of colonists from Barbados taking seed with them to the United States; and, according to Rivers ('Hist. Sketch South Carolina'), of Governor West having been instructed to obtain seed from Barbados; also of several cotton plantations being established in the United States during the sixteenth and seventeenth centuries, there is no means of ascertaining which cotton was thus actually conveyed from the West Indies. But we know for certain that the ancestor of the green-seed cotton was indigenous in Africa, certain parts of America, and the West Indies, and had been cultivated in those countries for centuries. Miller's green-seed cotton was an improved race of that indigenous stock. There is no positive knowledge of Sea Island cotton until well into the eighteenth century. The staple of greatest value with the pioneer planters was doubtless a plant very similar to (if not identical with) the Upland cottons of to-day. There is nothing to show that either the Sea Island plant, or the necessity for it, existed much before the middle of the eighteenth century. It is even now a special crop that can be produced only in a very restricted area, and for which there is not likely ever to arise a very much larger demand than at present. It can at all events alone pay when a high price rules; extended production is, therefore, exposed to the danger of ruinous reduction of price, but since only certain very special countries can grow it, that danger is thus perhaps not serious.

Sea Island cotton.

Barbados cotton.

Upland cottons

Egyptian improved cottons.

Cotton cultivation was systematically prosecuted in Egypt about 1821, and rapidly obtained a position in quality of staple second only to that of the finer grades of the United States, but there are no very clear indications as to the sources of the various stocks nor of the subsequent stages in their development. They are, however, nearly all exotic forms, chiefly *G. peruvianum*, *G. vitifolium*, *G. hirsutum*, and *G. mexicanum*.

First effort at Indian improvement.

The year 1825 witnessed ruinous speculations in cotton. From 1829 to 1841 the East India Company made strenuous efforts to improve the Indian staple. Large sums were spent in the form of awards, and ten experienced cotton-growers were procured from the Southern States of America with a view to establish the cultivation of New Orleans cotton. Excepting in Dharwar, failure was the only result, and the subject was thus allowed to drop from the public attention.

High counts

In 1841 cotton yarns were in Manchester spun up to 450s.

The first half of the nineteenth century witnessed the decline of all the British supplies of cotton, except that of the United States, which by then had obtained a monopoly of the market. In 1850 the imports of Great Britain were 664 million pounds of raw cotton, and the exports of manufactured cotton goods were valued at 28,000,000*l.*

Monopoly in the States.

In 1852 Sierra Leone began to cultivate cotton on the American system. In 1858 Dr. Livingstone returned to Africa, intending to give the cultivation of cotton his attention. He is reported to have said that 'in Africa the American cotton plant had become perennial.' Lord Palmerston prophesied that the West Coast of Africa would outstrip all other countries in the production of cotton, excepting only the United States.

Palmerston's prophecy.

A scheme was formulated in England to raise a sum of 20,000,000*l.* to be expended in India during five years in measures calculated to forward India as a cotton-producing country. The outbreak of the Mutiny put an end, however, to these negotiations.

Scheme to improve Indian production.

Commenting on the effect of the American Civil War and the great Cotton Famine of 1862–66, Dr. Charles W. Dabney ('U.S. Dept. of Agri. Bull.' n. 33 (1896), 'The Cotton Plant,' p. 14) very truly observes; 'Probably no equally great industry was ever more completely paralyzed or had its future placed in greater jeopardy than cotton-growing in the United States during the war of 1861–65. So great was the decrease in production which followed the effectual closing of the ports that only one bale of cotton was grown in 1864–65 for every fifteen bales raised in 1861–62. The chief menace to the future of cotton production lay in the efforts that were put forth by other cotton-growing countries at this time to produce those particular varieties which had for so long given the United States the monopoly of the European markets; and nothing could more completely demonstrate the remarkable adaptation of our Southern States to the growing of varieties which the experience of generations has proved to be the best for manufacturing purposes, than the fact that it took them only thirteen years from the end of the war to regain the primary position which they held at its commencement.'

American industry paralyzed.

In 1863 a Cotton Commissioner was appointed for Bombay, and the year following for Berar and the Central Provinces. Cotton farms were established under these Commissioners. The Bombay Cotton Frauds Act IX. of 1863, became law, but it is generally believed it did more harm than good, and it was shortly after repealed.

Second effort at Indian improvement.

India's expansibility.

For the ten years ending 1859, Great Britain imported an average of 2,318,575 bales of cotton (each 400 lbs.), and of that amount India supplied 405,291 bales. But the ten years ending 1869, which included the troublous times of the American War, Great Britain imported an average of 2,736,661 bales, of which India supplied 1,282,172 bales—the record year being 1866, when India furnished 1,847,759 bales. Thirty years later (1899) Great Britain took 4,065,617 bales, of which India furnished only 77,297 bales, and in 1903 the Indian portion slightly improved, Great Britain having taken 203,550 bales of Indian cotton. The immediate response made by India during the cotton famine shows her capabilities, but as in the United States, so in India, the demands of her own mills have now become the chief controlling factor in the amount available for export. The outcry in Europe was against the adulteration, not the low-grade staple. The position of Indian cotton in the European markets was as a mixing fibre, or as a fibre to be used in upholstery. The success of Western intelligent agriculture over Eastern ignorance and greed was rapidly assured, and in time the Indian cotton fell so low that it was practically debarred from being imported into Liverpool. But the century closed with India, instead of exporting cotton goods, having become the largest single market for English manufactured cottons, its demands having been just under 20,000,000*l.*

India imports cotton goods.

England's supremacy believed to be threatened.

The Twentieth Century.—This may be characterised by a new feature, namely, the rise of Continental, American, and Indian cotton-manufacturing enterprise, seriously threatening the supremacy of England in the cotton markets of the world. The Tariff Commission's Report of June 6, 1905, may be said to have been written with a view to establish this new phase. From that publication the following may be abstracted:—In 1876–80 the annual consumption of cotton in the United Kingdom exceeded that of the Continent by 2,030,000 cwt., and that of the United States by 5,070,000 cwt. In the period 1901–4 the annual consumption in the United Kingdom was 8,020,000 cwt. less than on the Continent and 2,950,000 cwt. less than in the United States.

Library
N. C. State College

CHAPTER II

THE COTTON FIBRE

The cotton fibre was first critically studied under the microscope in connection with the controversy as to the nature of mummy cloth. Mr. James Thomson, F.R.S., of Clitheroe, employed Mr. Bauer, of Kew, to examine and figure for him authenticated samples of both cotton and linen, and thereafter to critically study and compare with the types, thus established, some 400 specimens of mummy cloth. The results obtained were published in the 'Philosophical Magazine' (November 1834), and also by Yates ('Text. Anti.' pp. 261–5), and put an end, once and for all, to the controversy by establishing, beyond dispute, that mummy cloth was made of linen (flax), not cotton. The drawings produced by Bauer were not, however, sufficiently accurate to serve as standards in the future microscopic study of cotton, and the subject was accordingly taken up by many subsequent investigators, of whom the names of Varley, Walter Crum, E. Wilson, Bowman, and Monie must be specially mentioned. Mr. Walter Crum published, in 1863, drawings of the cotton cells or hairs, which are remarkably accurate, and Dr. Bowman delivered in Bradford a course of lectures, which were finally issued in the form of a goodly-sized volume, entitled 'Structure of the Cotton Fibre.' These lectures dealt with the practical aspects of the study on the arts of spinning, weaving, and dyeing cotton. The first edition of Dr. Bowman's useful book appeared in 1881, and a second was called for in the year following. It had the great advantage of being the work of a scientist who was also an expert cotton-spinner. Mr. Hugh Monie's work ('The Cotton Fibre: Its Structure, &c.,' published 1890) gives much additional and useful information. Dr. F. Royle and Dr. Forbes Watson both devoted considerable time and attention to the subject of the structure, length, strength, uniformity and other particulars of the various grades of cotton.

Microscopic examination.

The cotton cell.

For methods of examination and study, see Professor H. G. Greenish ('Micro. Exam. of Foods and Drugs,' 1903, pp. 23–6).

On the Continent of Europe an army of workers were in time also engaged in this inquiry, of whom mention may be made of Sadebeck ('Kulturgewächse der Deutschen Kolonien,' pp. 304–10); H. Lecomte ('Le Coton'); Vétillart ('Fibres Végétales,' 1876, pp. 130–40); Vesque ('Traité Bot.,' 1885, pp. 477–8); Semler ('Tropische Agricultur,' III., 1903, pp. 497–502); Julius Weisner ('Die Rohstoffe des Pflanzen-Reiches,' 1903, pp. 239–49), &c.

Unicellular hair.

Microscopic Structure of Cotton.—Cotton may be defined as a unicellular hair, formed from the cuticle of the seed. If the young ovule (shortly after fertilisation) be cut in section and examined under the microscope, it will be seen that the cuticle (on the immediate circumference of a transverse section) is warted, as it were, through the protuberance of certain superficial cells. If successive sections be made at different stages of growth, it will next be noted that these warts gradually elongate into unicellular hairs, and in time become the floss or wool of the cotton trade.

Cylindrical tube.

If now a mature cotton hair be examined, this will be seen to be not only unicellular, but to consist of a tube or cylinder broadest a little below the middle, gradually tapered toward the apex and more abruptly toward the base—that is, the end of attachment. It will further be noted that it is a transparent tube, and if taken from a seed found within a pod that had not opened, it may be discovered to be flattened lengthwise on itself and smooth; but if from a pod opened naturally, in the process of ripening, the cellular chamber may be observed to have become twisted on its own axis.

Twisted.

Repeated sections, made at various stages of the seed growth, will reveal the circumstance that, synchronous with the formation of a coating of floss outside, the embryo gradually matures inside the seed. It may thus be inferred that the external appendage of floss is intimately connected with the life of the germ: is intended, in fact, as an additional protection. (Cf. Cook, 'Weevil-resisting Adaptations,' 65–7.)

Metabolism of cotton cell.

Growth neither Constant nor Uniform.—If now the growth of the cotton cells themselves be watched, it will be seen that, as they elongate beyond the cuticular level, the nucleus of each, and its patch of protoplasm, gradually gravitate toward one side of the elongation, where they become as it were fixed. Soon thereafter the whole of the inner wall of the elongated cell is coated with

a thin lining of protoplasm, and at this stage indications are given of vigorous growth. The deeper-seated tissues of the seed, charged with nutritious matter, are now drawn upon in the metabolism of cotton (cell) formation. As a consequence, the coats of the seed gradually harden into a firm shell, covered with the now perfect wool coating. But it is most significant to record in this connection that the cotton growth is neither constant nor uniform.

Irregularity in growth.

Some of the cells would seem to grow more rapidly, others to start growth much later. In time the hairs at the pointed extremity of the seed become approximately one length, but shorter, as a rule, than those at the rounded end; and, moreover, in many instances the seed comes to possess an under fleece called the fuzz, owing to a certain percentage of the cuticular cells being only partially elongated while others are considerably more produced and formed into the outer fleece, the floss proper. (Cf. pp. 7–8, 41.)

Fuzz and floss.

Fuzz and Floss.—High cultivation cannot, however, be upheld as completely eliminating the fuzz and producing what is called the naked-seeded condition, since there is at least one truly wild species (never recorded as met with under cultivation, namely *G. Kirkii*) in which the seed is practically devoid of any trace of an under fleece though possessed of a fairly copious red-coloured and easily removable floss.

Uniformity essential.

It is of vital importance commercially that the floss or cotton be as near as possible of one length, and as near as possible of one age; hence the conditions that tend to uniformity in both these directions are quite as important as those that favour elongation —long staples. In the selection of stock with a view to improvement of staple, therefore, uniformity of growth or elongation, and uniformity of age or maturity, are highly essential qualifications.

No mature cotton (cotton where growth has ceased) that manifests a high percentage of short or imperfectly formed hairs, intermixed with fully-formed floss, can be regarded as of much value.

Thickening of the cell-wall.

Formation of Cellulose.—When growth is approaching completion it will be seen that a sort of thickening of the protoplasm has taken place, the nucleus has gradually disappeared, and secondary changes have been set up that have resulted in a strong cellulose wall. But here again these changes do not take place uniformly in all the cells, nor to the same extent throughout individual cells.

Cell-contents

Moreover, within the caverns of the young growing cells there are now seen very minute coloured particles that in time aggregate into

a central core known as the *Endochrome*—to the presence, extent and colour of which the floss owes its peculiar tint. In all wild cottons, for example, the *endochrome* gives a deep rusty hue (the *khaki* or red cotton). So very constant is this peculiarity of the uncultivated cottons that its appearance in the field may be accepted as an almost certain sign of a low-grade plant, or of defective cultivation or unsuited environment. It is in all probability a sign of 'reversion' to an ancestral and presumably hardier or more prepotent condition, when, with cultivated cottons, even a tendency toward that colour of staple becomes manifest. (Cf. p. 7.)

Khaki cotton.

Contraction and Twisting.—Thus the thickening endochromatic core imparts to the cell, by transmission, its particular tint and gives to it some of its special tinctorial reactions. To a peculiar colour may often be attributed the merit of a staple, as for example the *mit afifi* as compared with the *abassi* of Egypt. So again, mention has been made of the different appearances of mature cotton hairs, taken from pods before and after opening naturally. (Cf. p. 26.) It is necessary to enlarge on these subjects. In the first condition the cotton cells are seen to be flat filaments, in the second they have twisted into a spiral form.

Mature, immature and over-ripe cells.

If carefully examined it will be discovered that the cotton cells are thin along what may be called their central plane and slightly thickened outwards. In time this linear thickening becomes very pronounced, but if over-ripening be allowed to ensue the extra deposition of cellulose may cause a serious depreciation in value, the cells becoming in consequence semi-rod-like bodies, devoid of all elasticity and unsuited for spinning purposes. The normally produced secondary deposits are, however, in no instance uniform throughout the length of the cell. Thin portions are left here and there, and, since drying must take place more readily from these, contraction of the cell-wall at such positions would be but the natural consequence. With contraction exerted from the centre toward the circumference, spiral twisting becomes inevitable, and as this takes place at various parts of the cell simultaneously, irregular spiral twisting must necessarily ensue. It would seem probable however, as pointed out by Monie, that spiral twisting normally commences at the top and works toward the base of the cell—a consequence possibly of the earlier exposure of the extremity.

Irregular twisting.

Hygroscopic property.

The hygroscopic property of the cotton cell is one of its most interesting features. When not uniform the twisting is coarse and

irregular, thus giving the harsh woolly character so marked in some grades, and, when uniform, the fine soft silky condition of others. In certain cottons the rapidity with which the cells part with or absorb moisture is so remarkable that the twisting may take place even within the unopened pod. In other instances untoward climatic conditions may alter the character of the ripening crop, by prolonging the growth of the fibre beyond its proper extent (thus making the floss harsh and coarse), or by checking it before being sufficiently mature, in either case greatly depreciating its value.

Determination of season.

Season of Growth.—The length of the growing season, in relation to the time required by a crop, may necessitate either a change in the date of sowing or the substitution of a more suitable stock. With all new stocks or new localities test experiments should be made. For this purpose flowers should be marked that are fully opened at one and the same time, then allowed to ripen into fruit, and one of these registered fruits taken every few days and examined to see when the highest average maturity is attained. It seems probable that reaping a crop a little earlier than is customary, or in some cases a little later, or sowing a little earlier or a little later, might effect vast improvements.

Humidity of atmosphere.

So again certain staples, unfit for fine spinning when judged of purely by the standard of measurement, may, nevertheless, be spun into fairly high counts, as a consequence of their hygroscopic or other properties. In another passage (pp. 102–8), interesting particulars of this nature will be found, regarding the once far-famed Dacca cotton, the spinning of which, it would seem, was largely a study of the action of the humidity and electricity of the atmosphere and of the action of the cells themselves under certain bleaching waters. The Dacca spinners can to-day produce from one of the most inferior of all known staples a yarn quite as fine as that made in Europe and America from the finest and best known staples. This remains one of the enigmas of the cotton industry that would seem to point to the hand spinners being possibly able even to-day to teach machine spinners something they do not know. In this connection the well-known influence of humidity in the cotton factory may be brought to mind. The reader will find much useful information on that subject in a little book by Mr. B. A. Dobson, entitled 'Humidity in Cotton-spinning,' 1894.

Individual Merits in the Grades of Staple.—The theme of the structure and properties of the cotton cell might be detailed

indefinitely. Enough has, however, been said to show that the microscopic study of the floss, in structural and physical properties, gives one of the most certain of all keys to the improvement of the staple. The influences of soil, climate, season, &c., on the growth of the cells, their periods of maturity, extent and nature of cellulose deposits, strength of the cells formed, their colour and silkiness, degree of twisting, &c., are all vital aspects that must be closely watched in relation to the requirements of the market for which produced.

Trade requirements.

There can be no doubt that the trade does not wish one and the same staple from all the cotton tracts of the world. There are merits, apart from length, in almost every known cotton, that it becomes imperative to ascertain and develop. The influences of soil, climate, season, and methods of production upon the desired properties of the staple become, let it be repeated, the foremost considerations of the scientific cultivator.

Selection of stock.

No progress can be made where selection of stock on these lines is neglected; it is co-equal with selection of species or race grown.

But there are still a few other aspects of the microscopic study of cotton that are suggestive of practical results. Recapitulating some of the peculiarities already made out, in order to secure continuity, the cells may be said to close lengthwise as a first stage in their ripening and drying. The approximately parallel bands of thicker deposits thus come to appear as rounded margins to the resulting ribbons. Owing to these deposits being laid down irregularly, however, and leaving as already explained, thinner portions exposed to the drying influences, the ribbons rapidly get twisted on themselves.

Parts of the Cell.—Cotton hairs or fibrils may now be stained by the ordinary tinctorial methods in the laboratory, in order to bring out their structural peculiarities more clearly. Moreover, they will have to be examined both lengthwise and in transverse section.

Parts of the cell.

With such preparations carefully made it will be apparent that cotton cells (hairs) consist of the following parts:—

(*a*) The cell-wall or cuticular envelope of the elongated hair; (*b*) The deposits of cellulose laid down within and upon the envelope; and (*c*) The core of cell-contents filling up the central cavity.

Irregularity in Growth.—Presumably a bundle of cotton hairs, from a specially selected seed, may have been employed in making the preparations. If so it will readily be perceived that the three parts just mentioned are not in all cases equally developed; that is

to say, they are not present to the same extent in one cell as compared with another, nor in one part of the same cell as compared with another. There may be said to be many degrees and directions of irregularity, but three are specially noticeable:— Irregular development.

In one instance the cellulose may be observed to have formed but a thin lining to the cell-cavity; hence in drying such cells would naturally collapse and form almost transparent, flat, structureless ribbons. Under-ripe.

In another the cellulose deposits may have been carried to such an extent as to have almost completely filled up the cell. There being next to no central cavity remaining, the cells could not possibly collapse. Moreover, thinner portions not having been retained, here and there, irregular shrinkage and spiral twisting could not take place. Hence cells of this kind might very appropriately, therefore, be described as rod-like structures. Over-ripe.

In a third the cell-walls may be seen to have been formed intermittently, as it were; in other words, they are not throughout of one thickness. The cell-cavity is in consequence not uniformly tapered from base to apex. And this is the normal condition of all commercially mature cells, and in drying, as already explained, they become twisted. Ripe.

These, then, are some of the manifestations of irregular growth that pervade all samples of cotton. In every parcel there are young or imperfectly formed cells; over-ripe cells, and mature or perfectly formed cells. The under and over-ripe cottons are of little industrial value, and this explains why cotton picked too early fetches a low price in the market, and why over-ripe or late crops are often similarly of low grade. Unripe, ripe and over-ripe cells.

Superiority in production would be the extent to which want of uniformity had been eradicated or controlled.

This subject is so vital to the cotton industries that an apology need hardly be made for enlarging upon or even repeating these observations. Dr. Bowman, it will be seen by reference to his admirable work on the 'Structure of the Cotton Fibre,' devoted much careful study to the want of uniformity both in the comparative length of the staple and the degree of development found on one and the same seed. Although the methods and materials of research have advanced very greatly since his time, the practical observations he made have hardly in any direction been found wanting or depreciated in interest. It will not be out of place, Want of uniformity.

therefore, to furnish one or two passages from his work in the present connection.

'So great is the diversity in nature that we may say with truth that each fibre has a structure of its own, and differs in many particulars from all its fellows. Generally speaking, however, I have found that they may be divided into three classes:—

'1. Those where no internal structure is apparent.

'2. Where the structure seems to be simply tubular, with a well-defined transparent cell-wall.

'3. Where the structure is tubular, and the interior of the cell filled with secondary deposits which almost entirely occupy the internal cavity, giving the fibre a dense, almost opaque appearance.'

Dead cotton.

Dead or Kempy Cotton.—'Of course there are various degrees in the distinctness with which these characteristics are manifested in different filaments, and some observers have made many more divisions, dependent upon the length, thickness, and number of convolutions or twistings present in the various fibres in a given length; but it seems to me that for practical purposes these divisions are sufficient to cover all the various appearances presented, at any rate in the cultivated cotton.'

Dr. Bowman goes on to explain that the first of these classes occurs most frequently in early and unripe cotton, and he adds, singular to say, also in cotton that is over-ripe. The presence of 'solid structures, homogeneous and transparent,' is objectionable, since they are quite incapable of being permeated by the ordinary tinctorial methods, and give in consequence an unfinished appearance to goods made from yarn in which they are at all abundant. The dye-resisting portions are, he explains, analogous to the 'kemps' in wool fabrics. Further on he observes these kempy portions of the cotton staple often become continuous throughout the length of the cell, and, as might have been expected from the greater hardness and density of the hair, such cells appear more like transparent glass rods than examples of cotton. Apparently Bowman did not observe that protracted deposition, in obliterating or closing up the intermittent thinner parts, would of necessity result in straight, rigid, rod-like untwisted cotton, so that the same condition of kempy floss would result from both under and over-growth, the difference being chiefly in rigidity. Many subsequent writers have dealt with this subject and the so-called kempy condition has in trade come to bear the name of 'dead cotton.'

Kempy cotton.

Defective Agriculture.—In all defective agriculture, therefore, as also with wild plants left to a state of nature, the greater prevalence of kempy or dead cotton would be a natural enough circumstance. It is probably the case that the rod-like condition is the final form intended to be produced, and hence the less frequency of twisted cotton cells seen in wild as compared with cultivated species. And in this view it is significant that Bowman, so long ago as 1882, should have been able to add that the tendency to the kempy condition is 'a case of reversion,' for in that opinion he was unquestionably correct. Spruce ('Cotton Cult. in Peru,' p. 47) observes that the browner the staple the shorter and more brittle it becomes. Hanausek ('Tech. Mikroskopie,' 1900, p. 58), who has devoted some attention to the study of dead cotton, has come to the same conclusion as Bowman—namely, that it is commonest in the coarser grades (Levantine and Indian), and rarest in the Sea Island. Wild *versus* Cultivated staples.

The period of harvest must, therefore, in all successful cultivation, be the stage when a maximum of the so-called perfectly formed and spirally twisted cells has been attained. Harvest period.

Matured Fibres.—Concluding his observations on these issues, Dr. Bowman adds: 'The probability is, therefore, that in all bolls of cotton some of the fibres never attain maturity, from some cause or other, either their position on the matrix preventing their getting a sufficiency of light or nourishment, or some other reason interfering with the perfect development of the hair, the proportion of this fibre being more or less dependent on the character of the season and the health of the plant.' Speaking of perfectly-formed hairs, he remarks: 'The fully-matured fibres' are those 'where the tubular form is perfect and the twisting regular and symmetrical, while the tube-walls are solid and present distinct evidences of cellular or laminated structure.' Perfectly-formed cotton.

The Cell-cavity.—By staining cotton fibrils, the various structures, discussed above, are not only rendered more vivid, but it is shown that a considerable portion of the cell is filled up with the *endochrome.* This central chamber is most conspicuous along the lower two-thirds; in fact the upper third gradually tapers into a transparent cellulose (or 'kempy') solid beak, in which a central cavity and endochrome can hardly be spoken of as visible. But the study of the central cavity will once more emphasise the fact that the cellulose and endochromic materials are not by any The endochrome.

means uniformly deposited. It may in fact be noted that here and there the cell-wall is so thickened as to almost obliterate the cavity, thus occasioning what may be called cavernous spaces within the cell, and these are naturally most conspicuous near the base or thicker end of the cell.

The Cell-wall.—The wall usually occupies from one-third to two-thirds of the diameter of the cell. In the case of dead cotton, however, it may be so thick as to practically cause the lumen to appear as a thin tube. When critically and minutely studied the cuticular wall is found not to be homogeneous, but to consist of two irregular layers transversely striated.

Spiral twistings.

The longer the cells, the more uniformly are the deposits thrown down. That is to say, the thinner portions are smaller, more numerous and more equidistant, hence the greater abundance of the spiral twistings.

Conversely, the shorter the cells, the thicker they become; that is to say, the coarser the cellulose deposits, the thicker the cell-wall and the fewer and longer the twistings.

Stomata of cell-wall.

Recently an exceedingly interesting discovery has been made by Mr. H. de Mosenthal (see 'Jour. Soc. Chem. Ind.,' March 1904)—namely, that the cuticular wall is pierced by minute stomata leading into the lumen of the fibre. These stomata, hitherto unobserved, would offer an explanation of the way moisture, and with it tinctorial reagents, penetrate to the interior of the cell.

Measurements.

Cell Measurements.—The measurements of cotton are so intimately dependent on variable circumstances that at present even approximations to averages are of greater value than individual results. The variation in length and thickness of the staple is not only immediately governed by the species or variety of plant from which obtained, but even by the race or stock of each such variety. Hence, having secured a definite stock, the results obtained cannot be looked upon as constant, in one locality as compared with another, because of the staple being immediately influenced by the climate, soil, and season of production. Nor in fact can constancy be looked for even in the same locality, since abnormal climatic conditions will instantly disturb the results attainable. It follows, accordingly, that climatic and seasonal variations have to be standardised.

Variability.

Dr. Bowman very truly observes that it is a well-known fact that from year to year, in any class of cotton, such as Egyptian, the degree

of abundance of long or short-stapled cotton varies considerably, as well as the fineness and general silkiness of the fibre. While all this has been abundantly established, investigators who have examined cotton fibre hitherto have often ignored these factors and have far too frequently dealt with trade samples, assuming thereby that Sea Island, Egyptian, American Upland, Indian, Brazilian, &c., are terms that can be accepted as invariably denoting instantly recognisable staples.

I much regret that the time at my disposal has not hitherto allowed of my accomplishing more than a cursory examination of the cotton staples of the world, on the botanical standards of the species, varieties, and races. I have seen enough, however, to satisfy me fully that, when cotton improvement is seriously embraced as a professional branch of operations in the world's supply of this commodity, selection will have to be made, in the first instance at least, on the basis of specific standards. It accordingly becomes imperative that a series of investigations, sufficiently comprehensive, should be conducted in the future, with a view to establishing what might be spoken of as the standard measurements and physical characteristics of each recognisable botanical type. From some such record variability could readily be detected and selection made with a view to preserve the stock and ensure progression rather than retrogression.

Let me repeat once again, selection by no means should be governed by the presence on a seed of a percentage of long hairs, but infinitely rather by the high average manifested. That is to say, a seed that contained, say, 70 to 80 per cent. of hairs uniformly one inch in length and the balance shorter, would be of greater value than a seed which contained 15 to 20 per cent. of a staple $1\frac{1}{2}$ inches long and the balance considerably less than 1 inch. These are but theoretical figures intended to enforce uniformity in length as a better criterion than extreme length. Percentage of long hairs.

There could not be a greater folly than the deliberate mixing of a good staple with a bad. So also the growing of mixed grades, from this point of view, is highly reprehensible.

Standard Measurements.—Speaking in general terms, it may be said the known cotton staples range from less than one quarter of an inch in length (in some of the wild species) to fully two inches, in the higher-grade Sea Island cottons. It would occupy much space and time to review, however briefly, the information that

exists on this subject, and for the reasons already given would serve, very possibly, no very good purpose were the attempt made. Some years ago Evan Leigh ('The Science of Modern Cotton-spinning') gave a table that exhibited in inches the minimum, maximum, and mean lengths of certain flosses, as also of their corresponding diameters. That table has been drawn upon, apparently, by most subsequent writers, such as Evans ('The Cotton Plant,' &c., p. 77), Burkett ('Cotton,' p. 82), &c., but without any material progress being made in cotton measurements. Taking Leigh's maximum measurements only (for convenience), New Orleans was 1·16 inch; Sea Island, 1·80 inch; Brazilian, 1·31 inch; Egyptian, 1·52 inch; Indian indigenous, 1·02 inch; American, grown in India, 1·21 inch; and Sea Island and Egyptian, grown in India, 1·65 inch. Leigh brought out the additional and important fact that the shortest staples had the greatest diameter—Indian indigenous having a maximum diameter of ·001040 and Sea Island ·000820. Thus the longest fibres have also the smallest diameter. The so-called Egyptian was revealed as the most regular both in length and diameter of the fibre, the greatest difference being $\frac{25}{100}$ of an inch and $\frac{1}{769}$ of an inch respectively. Sea Island, while possessing the greatest length and fineness of fibre, exhibits, on the other hand, the greatest variation, viz. $\frac{39}{100}$ of an inch in length and $\frac{1}{2777}$ of an inch in diameter of the individual fibres. It is commonly stated that, on average, Sea Island cotton is about one-third the diameter and three times the length of an average Indian staple. Thus the finest and coarsest staples may be spoken of as having approximately the same cavity area—that is to say, are capable of receiving about the same amount of secondary deposits of cellulose. (Cf. Wiesner, 'Die Rohstoffe, &c.' pp. 244–5).

Short and thick staples.

Chemistry of the Cotton Cell.—Many questions of adaptability to spinning, dyeing, and other industrial purposes depend largely, no doubt, on the structural and physical conditions of the floss itself and on its chemical characteristics. Briefly, cotton may be described as cellulose with about 3 per cent. of other substances, such as colouring material, pectin, wax, and albuminous materials. Most of the issues of its chemical composition lie, however, beyond the scope of this work, which has been framed to deal primarily with questions affecting production. One or two features of the chemical investigations may, however, be briefly mentioned, since some of them may be utilised in testing the results attained in cultivation.

Some few years ago I was associated with my friends Messrs. Cross, Bevan and King in the publication of a little book on 'The Indian Fibres and Fibrous Substances' (published by E. & F. N. Spon, London, 1887), in which a method of chemically investigating fibres was described by these distinguished chemists (more especially by Mr. Cross). The following abstract of some of the points brought out may be given here:—

1. *Moisture.*—All the celluloses hold, in their ordinary state, a certain proportion of moisture. This may be called the water of condition, which, within the limits of variation (1 to 2 per cent.) due to atmospheric changes, is definite and characteristic of each fibre. The proportion of hygroscopic moisture may be used as an index of susceptibility of attack by hydrolytic agents. The textile fibres of the highest class are distinguished by low moisture. To ascertain the moisture present the fibre requires to be heated to 110°. Bowman states that the quantity of water in cotton varies with different seasons from 1 to 4 per cent. in the new crop, and rather less as the season advances.

Other observers have accepted a higher percentage of moisture as occurring in ordinary trade samples, say up to 7 or even 12 per cent. Mr. T. C. Bradbury, of Gartside and Co., Manchester (according to Hannan in 'Textile Fibres of Commerce,' 1902, p. 89), 'made a number of experiments to determine what should be considered a reasonable amount of moisture in cotton. He found that ordinary raw cotton, after being exposed for several days in the usual process of manufacture to the working temperature of a mill, viz. from 70° to 80° F., till a balance of moisture was obtained, and then placed for twenty-four hours on the ground floor of a building open to the outer air, absorbed from 1·6 to 3·6 per cent. of moisture, the amount varying with the state of the weather. In other words, cotton in its ordinary marketable condition would lose moisture in the course of manufacture about 5 per cent., and afterwards the yarn made from it, exposed for some time to a Lancashire atmosphere, would regain from 2 to 4 per cent. of moisture.' The question of the behaviour of the various species, under the influence of moisture, is a subject never apparently critically investigated, and yet upon that very issue, it will be seen, the Dacca hand-spinners of the yarn used for the fine muslins of that town lay great stress (p. 106). Mr. B. A. Dobson ('Humidity in Cotton-spinning') deals in an able manner with the subject of the influence of atmospheric

humidity and temperature in the factory, and his work should be consulted. (Cf. Cross and Bevan, 'Paper-making,' 1900, pp. 95–6.)

2. *Mineral Constituents.*—This is the percentage of ash left after burning the fibre.

3. *Hydrolysis.*—This may be characterised as the bleaching of fibres. It can be accomplished by either acids or alkalis, the latter from choice. A solution of 1 per cent. caustic soda is used. The fibre is boiled in this for five minutes, a second portion for one hour. The loss in weight in the former is the proportion that yields to the solvent action of the alkali; in the latter, the degree of degregation, due to the hydrolytic action.

4. *Cellulose.*—A specimen of fibre, having been boiled in the 1 per cent. solution of caustic soda, is washed thoroughly, then exposed for an hour, at the ordinary temperature, to an atmosphere of chlorine gas. It is then removed, washed, and treated with a solution of sodium sulphite, which is slowly raised to the boil. After two or three minutes' boiling, it is washed, dried, and weighed.

The percentage yield of cellulose, on the raw fibre thus obtained, is the most important criterion of its composition and value.

5. *Mercerising.*—The action of concentrated solutions of the alkalis upon vegetable fibres is an important feature in the diagnosis of their composition. The structural modifications which the cotton fibre undergoes by this treatment, were originally observed and made known by Mr. John Mercer in 1850—hence the expression 'mercerising.' So far as the chemistry of the action has been made out, the hydration changes which it sets up are in the direction of resolving the fibre substance into cellulose and non-cellulose. The fibre is thoroughly wetted with a concentrated solution (33 per cent.) of the alkali, which is allowed to act for one hour. The fibre is then washed, dried, and weighed. The cells shorten in length, but swell out in diameter, become transparent and gain both in strength and weight, and moreover turn glossy and silky in appearance.

Mercer observed that when cotton fabrics were soaked in a solution of caustic soda of *sp. gr.* 1·3 or 1·4 they became stronger and fuller, converting thin and coarse cloth into strong and fine, and at the same time giving greatly increased and improved powers of receiving colour and of making the colours more permanent. Thus three very important and remarkable changes were, he pointed out, effected at one and the same operation: the fibre became stronger, finer, and manifested an increased affinity for tinctorial reactions.

The exact degree of improvement effected with a standard mercerising preparation might, it seems probable, be resorted to as a method of testing the comparative merits of the fibres of different species of cotton and of the staples produced experimentally at cotton improvement farms.

6. *Nitration.*—Cotton, when treated with concentrated nitric acid, is converted into explosive compounds, which are now recognised to be nitrates of cellulose. All celluloses are similarly acted upon, and the study of the resulting compounds is a necessary feature of the diagnosis of fibres. For this purpose Cross and Bevan recommend, as a nitrating fluid, a mixture of equal volumes of concentrated nitric acid (*sp. gr.* 1·42) and sulphuric acid (*sp. gr.* 1·74). The fibre is subjected to this for one hour at the ordinary temperature.

This causes an increase in weight, the extent of which in one as compared with another fibre is a point of great importance. The net increase in fibres ranges from 5 to 55 per cent.

7. *Combustion: Carbon Percentage.*—A rapid process of ascertaining the carbon percentage was introduced by these chemists, and consists in burning the substance with chromic anhydride in the presence of sulphuric acid and leading over the gaseous products into an apparatus in which their volume can be exactly measured. Accepting cotton as typical cellulose, the amount of carbon obtained by ignition is 44·4 per cent. The lower carbon percentages are from 40 to 43, the higher 45 to 50. In the former the pecto-celluloses are included, and in the latter the ligno-celluloses.

8. *Acid Purification.*—To clean a fibre and remove all accidental impurities it is heated to boiling point in a 20 per cent. solution of acetic acid, then dried and weighed. The loss of weight sustained shows the impurities.

Doubtless some of these methods and contrivances may not be necessary when attention is confined to cotton. I have thought it likely to prove useful, however, to record Mr. Cross's system of examining the merits of all fibres in as nearly complete a form as space would admit of in this work.

Cuprammonia (*Cuoxam*).—But it may be added that the value of cuprammonia in the examination of cotton has been urged by many writers. This was pointed out originally by Schweitzer, and detailed shortly after by Charles O'Neill ('Calico Printing, Bleaching and Dyeing'), and has since been elaborated in every direction by numerous investigators and practical operators. (Cf. Greenish, *l.c.* p. 308.)

Inner layer first affected.

The action of the copper salt seems directed primarily on the inner layer of the cellulose and extends through the thickness, causing the secondary deposits to separate from the cuticular wall. Bowman was apparently much distressed that he could not resolve the outside membrane into what he supposed to be its constituents, while he was able by the means indicated to completely break up the cellulose deposits formed within the cell. (Cf. Wiesner *l.c.*, pp. 246–8.)

These experiments are interesting, and, if applied to the determination of the extent and nature of the deposits produced within the flosses of the various species of *Gossypium*, might help very greatly in the establishment of standards for comparison and critical study.

Strength of cellulose.

One of the aspects in cotton production vital to success is the strength and quality of the cellulose. By chemical tests useful particulars in that direction may be established, but mechanical means, such as the contrivances discussed by Dr. Bowman, become imperative before any practical experience can be established as to the strength of the various cottons. The breaking-point of the different grades becomes, in fact, a feature of great industrial value. Mr. Charles O'Neill (*l.c.*) devoted much attention to this subject, and his work should be consulted. He found that Sea Island broke with a strain of 83·9 grains, whereas Surat sustained 163·7 grains. (Cf. Hanausek, *l.c.*). I regret that I have not the opportunity nor the time to conduct such experiments, and do not think it necessary to republish the results obtained by Bowman and others, since those interested are likely to consult the original publications rather than a mere abstract of the conclusions arrived at.

Influence of cotton on the soil.

McBryde and Beal give (in Charles W. Dabney's 'Cotton Plant') a special chapter on the chemistry of cotton. This may be characterised as a review of the chemical literature assorted under the various parts of the cotton plant—such as the entire plant, the roots, the stems, the leaves, the bolls, the lint, &c. Under the last-mentioned heading they say that the lint constitutes 10·56 per cent. of the mature plant. An elaborate table of analyses makes it clear that, if the lint were the only part removed from the soil, cotton would be one of the least exhaustive of farm crops. While McBryde and Beal have produced a chapter of great practical value, the chemistry of cotton has still, however, to be undertaken by original investigators before it can be accepted that we are in a position to understand and identify even the chief commercial grades.

The cotton fibre has nevertheless been studied by many independent

workers, and numerous methods of distinguishing it from other fibres established. (Cf. Wiesner, *l.c.*, pp. 249–52.) One of the simplest is, perhaps, that given by Dr. Herzog—namely, by steeping the fabric of mixed cotton and linen in a lukewarm alcoholic solution of cyanine for a few minutes, then rinsing with water and treating with dilute sulphuric acid. The acid bleaches the colour from the cotton, but leaves the linen unaffected, and the blue of the linen may, as an additional test, be afterwards intensified with ammonia. Test for cotton.

Classification of the Cotton Flosses (cf. pp. 7, 27, 56, 62).—In the next chapter particulars will be found regarding the appearance of the individual flosses of the various wild species of *Gossypium* (that is to say, the species not found under cultivation). The following popular classification of these may be here given:—

(*a*) Forms with both a fuzz and a floss, but the latter too poor and scanty to be worth collecting; the plants otherwise, in many particulars, closely resemble cultivated forms. These are accordingly open to the suspicion of not being truly wild plants—of being, in fact, survivals of a former cultivation. But in support of their acceptance as wild species, mention may be made of the fact that the fuzz (if not the floss also) is usually rust-coloured. The best examples of this group are:—*G. obtusifolium* (p. 139) and *G. punctatum* (p. 168). Fuzz and floss.

(*b*) Undoubted wild species that possess both a fuzz and floss, the former always (if not the latter as well) rust-coloured, but so short as to be of next to no industrial value:—*G. mustelinum* (p. 167), *G. Palmerii* (p. 204), and *G. Schottii* (p. 206).

(*c*) Wild species with a coating of rust-coloured wool that can hardly be described as more than a fuzz. This is certainly not referable to two layers, and can only be removed by being torn from the seed:—*G. Sturtii* (p. 63), *G. Davidsonii* (p. 65), *G. Harknessii* (p. 73), *G. Darwinii* (p. 68), *G. tomentosum* (p. 69), *G. drynarioides* (p. 71), and *G. Stocksii* (p. 73). Rust coloured fuzz.

(*d*) Wild species devoid of any fuzz, but with a readily separable floss of a rust-colour:—*G. taitense* (p. 248) and *G. Kirkii* (p. 316). Floss alone present.

Important Deductions.—There are other species, often met with in admittedly acclimatised conditions, and which, under these circumstances, very frequently assume a rust-coloured fuzz, or rust-coloured floss, such as *G. Nanking*, *G. hirsutum*, var. *religiosa*, *G. purpurascens*, *G. brasiliense*, &c. These have all at some time or other been called the sacred cottons (*G. religiosum*), the *nankeen* cottons, or simply Sacred cottons.

red or *khaki* cottons. Buchanan-Hamilton regarded a red floss as uniformly denoting but one species, for which he suggested the name *G. croceum*.

Wild cottons.

There are, moreover, still other truly wild species which, with fuller knowledge, would doubtless find places in one or other of the above groups. I have only mentioned the species of which I have examined ripe seeds, and am thus in a position to speak of their flosses. But the assortment as it stands is, I venture to think, highly instructive. It brings out certain peculiarities with which it is imperative the cultivators of the cotton plant should be familiar. Of these the following may be pointedly indicated:—

Rust-coloured wool.

1. A rust-coloured woolly coating of the seed would seem to be an almost generic peculiarity of *Gossypium*. The presence of a white fleece may accordingly be regarded as a condition brought about by cultivation. All known truly wild species have a red-coloured woolly coating to the seed, which may or may not be referable to two layers, an inner, or fuzz, and an outer, or floss. The presence of a red tint in the fuzz or floss is accordingly either an indication of low-grade staple, or a manifestation of degeneration —a reversion to the ancestral type.

Naked seeds.

2. The presence or absence of a fuzz to the seed cannot be accepted as an accidental circumstance of no value. There are wild species that possess both a fuzz and floss (that is to say, have velvety seeds), others that have a fuzz but no floss, and still others that have a floss but no fuzz; they possess, in other words, what are called naked seeds.

Variation.

There is every reason, therefore, for believing that these peculiarities were originally more or less fixed (as they are to-day with all the undoubted wild species), and might have been accepted as affording a satisfactory basis for a scientific classification into the three or four groups above indicated. But cultivation and hybridisation, and perhaps also natural adaptation to altered environment, have undermined the value of these characteristics; hence it is no uncommon experience for the progeny of a naked seed to become fuzzy-seeded, or *vice versa*. Man has carried the cottons of one region to another, and often subjected them to absolutely foreign influences. We must, therefore, discover some satisfactory explanation of this special or increased tendency to variation; but the fact remains the same, that with pure wild species the peculiarities of the fuzz and floss are of undoubted specific if not of sub-generic value.

3. Similarly the character of easily separable floss would not seem to be an acquired one in cultivation; in other words, it is not necessarily a consequence of man's selection. It is a condition that prevails naturally, with certain undoubted wild species, but which very possibly has been taken advantage of in industrial selection and thus intensified by man. The firmly adherent flosses could only be removed by being plucked off by hand or by means of specially constructed gins—'saw-gins.' The end of the staple has thus to be torn from the seed cuticle. All such staples are accordingly ruptured, and, seen under the microscope, have their lower thicker ends irregularly burst open. The easily separable flosses, on the other hand, often seem to part from the seed naturally, to fall away from the cuticle like ordinary caducous hairs, the result being that under the microscope mature cotton fibrils of this kind manifest little or no evidence of the rough treatment characteristic of the other staples. (Cf. with p. 246.)

Separable floss.

This is an industrial distinction of no small importance.

4. Of the four groups above indicated perhaps (*c*) those with a fuzz not referable to two layers (an outer and an under coat) are of least value to the cotton-grower. None of the members of that group seem ever to have been cultivated, or to have in any way contributed to the cultivated stocks of the world. They are, however, the most widely spread assemblage; for example, *G. Sturtii* is found in Australia. *G. Davidsonii* and *G. Harknessii* in California, *G. Darwinii* in the Galápagos Islands, *G. tomentosum* in the Hawaiian Islands, and *G. Stocksii* in India and Arabia. And it may be added that structurally they are the least cotton-like members of the genus *Gossypium*, their free and often clawed bracteoles bringing them very near to *Fugosia* and *Thespesia*. Were a selection of the wild species to be drawn up with a view to some of them being used as possible future stocks of improved cotton staples, the existence of the series of fuzz- but not floss-yielding forms might safely be ignored. And this statement sweeps away, I trust, satisfactorily and accurately the misconception, entertained by some writers, that *G. Stocksii* may be the ancestral form of *G. obtusifolium*, if not of *G. herbaceum*.

Fuzz but not floss.

5. The exclusion of the non-floss-yielding species practically leaves two groups that have to be considered, since (*a*) and (*b*) can be united into one, viz. those that possess both a fuzz and floss and those that have a floss only. But let it be here added that, of the

Floss but not fuzz, naked seeds.

cultivated cottons, there is practically no such thing as a completely naked seed. The Sea Island cottons, perhaps by far the most highly specialised series to man's necessities, have almost invariably a minute crown of velvet (fuzz) surrounding the beak. *G. Kirkii* (an undoubtedly wild species and one never recorded as met with under cultivation) is the only cotton, so far as at present known, that possesses a truly naked seed, but even with this species a few hairs seem to adhere more firmly to the apex of the seed. In this respect the cultivated plant that could be regarded as coming nearest to that condition is the kidney cotton, *G. brasiliense*. And it is worthy of passing note that of all the known wild species *G. Kirkii* approaches nearest, in other characteristics, to *G. brasiliense*. The leaves have much the same shape and texture, and in the herbarium dry into the same dull brown-black shade; moreover the seeds are singularly alike, if the kidneyed condition be disregarded.

Fuzzy seeds.

Of the fuzzy-seeded species it might almost be said there are two great groups: first, an Asiatic-African and, second, an American. It will be seen that with some hesitation I have placed a wild or at all events long acclimatised plant, found in the eastern tracts of tropical America, under *G. punctatum* (see p. 170). It would, from the contention here set forth, have been perhaps more satisfactory to have retained that plant under the name once given it, viz. *G. jamaicense*. Across the Atlantic, on the western tracts of tropical Africa, is found the true *G. punctatum*. These two plants, whether viewed as independent species or as varieties of one common species, might fairly well be described as demarcating the fuzzy-seeded cottons. On the one hand there is the well-marked group formerly called by writers on this subject 'the Asiatic cottons,' though these are equally well represented in Africa, Egypt, and Arabia. On the other hand there is an assemblage of fuzzy-seeded cottons, confined apparently to America (Central and South more especially), that has hitherto been entirely overlooked.

These two groups may be represented — The Asiatic by *G. arboreum*, *G. Nanking*, *G. obtusifolium*, and *G. herbaceum*; The American by *G. mustelinum*, *G. Palmerii*, *G. fruticulosum*, *G. Schottii*, and *G. lanceolatum*. Wedged in (structurally and geographically) between these remarkable assemblages stands *G. punctatum*, which, as already stated, crosses the Atlantic to dominate Western Africa on the one shore and Eastern America on the other.

Trade Standards.—It may be said, briefly, that the data upon which commercial valuations depend seem to turn on species of plant, locality of production, length of staple, diameter of the cells (fineness or coarseness), colour and texture (silky, woolly, &c.), moisture, and the 'count,' or length of yarn that can be spun from a fixed quantity of each grade. The spinning property would not seem to depend exclusively on the length of staple. Commercial valuations.

Hannan ('Textile Fibres of Commerce,' pp. 94–96) furnishes an elaborate table of the chief grades of cotton known in European commerce, which the reader should consult. The more instructive particulars may be indicated as follows:—

1. *Sea Island Cottons.*—The grades of these are known as 'Edisto,' 'Florida,' 'Fiji,' and 'Tahiti.' The first-mentioned yields a staple 2·20 inches, the others under 2 inches—the lowest being Fiji, 1·75 inch. These afford counts technically expressed as from 100s to 400s.

2. *Egyptian.*—The grades known are designated 'Brown,' 'Gallini,' 'Menouffieh,' 'Mitaffifi,' and 'White.' The longest staple is the Gallini, 1·60 inch, and the shortest the White, 1·0 inch. These may be spun into counts that range from 70s to 250s.

3. *Peruvian.*—'Rough,' 'Smooth,' and 'Red.' The staples in these range from 1·0 to 1·25 inch, and the counts from 40s to 70s.

4. *Brazilian.*—The grades are numerous, such, for example, as 'Pernams,' 'Maranhams,' 'Céará,' 'Paraiba,' 'Rio Grande,' 'Maceio,' 'Santos,' 'Bahia,' 'Aracajua,' and 'Aracatti.' The staples in these range from 1·15 to 1·50 inch, and the yarns that may be spun from 40s to 60s.

5. *American.*—The special grades mentioned by Hannan are 'Orleans,' 'Texas,' 'Allanseed,' 'Mobile,' 'Norfolks,' 'St. Louis,' 'Ronoaks,' 'Boweds,' 'Benders,' 'Memphis,' 'Peeler's,' 'Uplands,' 'Alabama,' 'Linters,' and 'Tennessee.' These have staples that range from 0·9 inch (in St. Louis, Ronoaks, Alabama, and Tennessee) to 1·20 inch 'Allanseed.' The shorter kinds are spun into counts of 30s and the longer into 50s or 60s.

In another place (pp. 231–41) a further statement of the grades of American cottons will be found, but it is worthy of remark, in passing, that Hannan treats 'Uplands' as a separate and distinct grade, apart from the others named by him, instead of being the collective appellation for the entire series, the opinion held in the States. From the botanical point of view this is interesting, since Uplands.

it is possible the shorter grades mentioned are hybrids, nearly related to *G. hirsutum*, and the longer (the Uplands proper) are mainly hybrids that closely approximate to *G. mexicanum*.

6. *Greek, Italian, and Turkey.*—These have each independent positions in Hannan's classification. I bring them together into one place, since they are all forms of *G. herbaceum*, and constitute the Levantine, Malta, and Smyrna cottons of the early cotton commerce of Europe. The grades mentioned by Hannan are Smyrna, Calabria, and Levant. The Calabria has a staple 0·90 inch, Levant 1·25 inch, and Smyrna 1·25 inch. They accordingly afford counts that range from 26s up to 40s.

7. *African*—or Lagos cotton.—This, it would appear, has a staple of 0·80 inch, and may be spun into counts of 20s to 26s.

8. *West Indian.*—According to Hannan, the grades of cotton classed as West Indian are 'Carthagena' and 'La Guayran.' The former has a staple 1·5 inch long, and would appear to afford counts of only 26s, while the latter is 1·20 inch but yields 40s.

Since the date of Hannan's 'Textile Fibres,' the West Indies proper have begun, however, to grow cottons, and the imports into Great Britain of Sea Island cottons from these colonies have already assumed considerable proportions and bid promise of a great future.

9. *China.*—This country is said to produce, apparently, but one grade—a rather harsh, short staple, 1·0 inch long, and of which counts up to 30s may be spun. It is probable that this view greatly underestimates the Chinese and Japanese cottons.

10. *Australia—Queensland.*—Produces, according to Hannan, a long white, silky cotton that measures 1·75 inch, and may be spun into counts of 120s to 200s.

Amraoti, Hinganghat, Kumpta.

11. *Indian Cottons.*—The grades of this class mentioned by Hannan are 'Oomrawuttee,' 'Hingunghat,' 'Comptah,' 'Broach,' 'Dharwar,' 'Assam,' 'Bengals,' 'Bilatee,' 'Dhollerah,' 'Surat,' 'Scinde,' 'Tinnevelly,' 'Bhownuggar,' 'Cocoanada,' 'Bourbon,' 'Khandeish,' 'Madras' or 'Westerns,' 'Rangoon,' &c. I give these names as used by Hannan, since they possibly are those best known to the European markets. In another part of this work (pp. 81–153) it will be seen I have attempted a classification into varieties and races of the chief Indian cottons. According to Hannan the staples range from 1·0 to 1·05 inch (in the Oomrawuttee, Hingunghat, and Bhownuggar—indigenous cottons—and in the Dharwar and Bourbon exotic cottons) to 0·5 or 0·8 (the Sind, Assam, and Bengal).

The average good cottons of India are the Broach, 0·90 inch Karachi (special cotton), 0·90 inch; and Tinnevelly, 0·80 inch.

English terms.

Within these locality denominations, the trade cottons are graded according to certain terms universally accepted as having definite and relative meanings. They are indicated by a series of letters that have a fixed signification with each group. For example, the Uplands or American short staples are spoken of as 'G.O." (= Good Ordinary); 'L.M.' (= Low Middling); 'Md.' (= Middling); 'G.M.' (= Good Middling); 'F.G.M.' (= Fully Good Middling); and 'M.F.' (= Middling Fair). 'G.O.' is therefore the lowest quality officially recognised and 'M.F.' the highest, that is to say the longest of these cottons.

The Egyptians are quoted under similar terms, such as 'Fr.' (= Fair), the lowest; 'G.F.' (= Good Fair); 'F.G.F.' (= Fully Good Fair); and 'Gd.' (= Good), the best quality.

The Indian cottons are recorded as 'F.F.' (= Fully Fair); 'F.G.' (= Fully Good); 'F.G.F.' (= Fully Good Fair); 'Gd.' (= Good); 'F.G.' (= Fully Good); 'Fine'; 'S. Fine' (= Superfine).

The Brazilians have fewer designations: 'M.F.' (= Middling Fair); 'Fair'; and 'G.F.' (= Good Fair).

Of Sea Islands the terms are 'Ord.' (= Ordinary); 'Com.' (= Common); 'Med.' (= Medium); 'Good Med.' (= Good Medium); 'Med. Fine' (= Medium Fine); 'Fine'; and 'Extra Fine.'

American terms.

In a communication which I have had the pleasure to receive from Mr. Lyster H. Dewey (Botanist in Charge of Fiber Plants, in the Bureau of Plant Industry, Washington) the following passages occur:—'In accordance with a request received from you some time ago for more definite information regarding the trade names of cotton, I have written the secretaries of some of the principal cotton exchanges to secure at first hand the information desired.

'There are two classes of trade names used in the market. Such names as Sea Island, Georgias, Peelers, Benders, Upland and Allen refer to the variety or class of cotton, while another series of names, such as ordinary, low middling, middling, fair, &c., refer to grade and apply to all of the different classes of cotton as they are placed upon the market. I will enclose herewith a copy of a list of the grades such as are recognised in the New York cotton market. The grade "middling" is taken as the basis for all contracts. Grades above middling are purchased at a premium or command a price above that of the ordinary quoted market price, while grades below

'Middling' the basis of contracts.

middling have a corresponding discount. The grades do not seem to be very sharply defined. In fact, it would seem very difficult to give accurate descriptions that would define the thirty different grades, all of which to a non-expert would look very much alike in the bale. The definition given for cotton to be graded 'fair' states that it must be free from mote, gincut and all foreign substances. Samples of the various grades are kept at the principal cotton markets, and the bales are graded by comparison with sample.'

'*Inspection Bureau, New York Cotton Exchange; New York Differences in Grade:—*

		Cents.	
Grades of cotton.	Fair	1.30	on
	Strict Middling Fair	1.13	„
	Middling Fair	.96	„
	Barely Middling Fair	.79	„
	Strict Good Middling	.62	„
	Fully Good Middling	.53	„
	Good Middling	.44	„
	Barely Good Middling	.33	„
	Strict Middling	.22	„
	Middling	Basis	
	Strict Low Middling	.14	off
	Fully Low Middling	.26	„
	Low Middling	.38	„
	Barely Low Middling	.55	„
	Strict Good Ordinary	.72	„
	Fully Good Ordinary	.86	„
	Good Ordinary	1.00	„
	Strict Good Middling Tinged	.30	on
	Good Middling Tinged	Value of Mid.	
	Strict Middling Tinged	.06	off
	Middling Tinged	.12	„
	Strict Low Middling Tinged	.34	„
	Low Middling Tinged	.50	„
	Strict Good Ordinary Tinged	.84	„
	Fully Middling Stained	.42	„
	Middling Stained	.50	„
	Barely Middling Stained	.78	„
	Strict Low Middling Stained	1.06	„
	Fully Low Middling Stained	1.28	„
	Low Middling Stained	1.50	„
Sea Island cottons.	East Floridas	26	cents.
	Fancy Georgias and Floridas	25	„
	No. ones	24–½	„
	No. twos	23–½	„
	No. threes	22–½	„
	No. fours	21	„

The last six quotations 'are names and prices mentioned in the report of a committee of the Association of Sea Island Cotton Growers, of Georgia and Florida, which met in September, 1906, at Valdosta, Georgia. The names, as you will observe, apply only to the inland Sea Island cotton. The term East Floridas does not mean cotton grown on the islands along the coast of East Florida, for cotton does not seem to be cultivated along the coast of either Georgia or Florida.'

Such, then, are the chief grades of each of the above-mentioned classes as recognised by the Liverpool and Manchester Cotton Brokers' Association and by the New York Cotton Exchange. But length of staple is by no means the only criterion. Two cottons of the same length, the one Upland American and the other Egyptian, would not be classed as identical. The country of production and species of plant grown are recognised as imparting distinctive characteristics.

Thus, for example, the Brazilian staples are collectively viewed as harsh though strong. The Sea Islands of Georgia have not only exceptionally long and strong fibres, but great uniformity in thickness.

Empirical Tests.—These varying qualities of cotton are determined by certain empirical tests for which the skill and highly-cultured sensations of the expert are indispensably necessary. The more obvious, to the uninitiated, would be the percentage of dirt (sand or mud) that can be shaken from a weighed sample on to a clean piece of white paper, or the amount of leaf (fragments of bracteoles as a rule) with which the sample is mixed. The condition of the leaf is also deemed as instructive. If much broken it gives, for example, the additional indication of the severity of treatment during ginning, the fibres being in consequence very possibly torn or broken. The colour or degree of staining, through inferior cultivation or disease (boll-stained), is still another obvious condition of depreciation, and the amount of natural moisture present can readily be appreciated as an important factor, without that moisture being supposed to have been artificially imparted. The differences between cottons, such as the *lalio* (p. 150) and *wagria* (p. 152) of Gujarat, are, in other words, definitely recognised by the trade. In the former the pod not only bursts but the floss emerges and becomes fully opened out and dried in the sun and wind, some time before it is gathered. In the latter the pods never completely open, are in fact often

Dirt.

Colour.

Moisture.

gathered in the green state and ripened in the collector's house, the pods being artificially broken open and the floss pulled out by hand, at the convenience of the owner. These are doubtless extreme examples, but are representative of well-known conditions of maturity. So again the cottons of certain countries, or the crops of certain seasons, that mature their staples with the damps and colds of the approaching autumn, are necessarily different from flosses matured in spring with the increasing heat and dryness of the approaching summer. The North American cottons arrive in Liverpool about the end of September or beginning of October, the Egyptian and South American nearly a month later, but the bulk of the Indian cottons do not reach Europe much before March.

Maturity.

Ripening with increasing temperature.

The expert judges the value of cotton by certain tests, the value of which can only be ascertained by long technical training. A tuft of the floss is taken up and held firmly between the forefinger and thumb of each hand, then pulled apart. The two portions are next placed on the top of each other and the 'pulling' repeated until a clean sample has been prepared, all the threads of which lie parallel to each other. This exhibits the mean length of the sample. It is customary for the brokers to lay each tuft of floss, as prepared, on the sleeve of the left arm and to make several such from the different parts of each parcel, the series being then compared as to uniformity in length and other properties.

Pulling cotton.

Length.

But while 'pulling' asunder, the degree of resistance is noted—an exceedingly delicate test that only long experience can acquire—by which some conception of the degree of twisting in the individual cells is ascertained. Lastly, the strength of the staple is determined by taking up one of the drawn samples, and holding it firmly between the forefinger and thumb of each hand, a sudden sharp strain or jerk being then given, by which the expert judges of the strength of the staple.

Strength.

These and such-like are the hand and eye tests by which the bulk of the cotton is bought and sold to-day, but though to the uninitiated it seems a jargon of meaningless tests and terms, the transactions are satisfactorily accomplished and the standards readily understood by the experts of the cotton world.

Standards understood.

Contracts.—It would be beyond the scope of this work to discuss the forms of transactions. It may suffice to observe that 'Cotton Futures' are contracts at certain dates on prices previously agreed upon. This gives the spinner assurance to accept orders for yarn.

Cotton Futures.

Mr. Charles Stewart, in a paper read before the British Association on September 26, 1896, explained the expressions used in these sales. The standard previously accepted is the 'middling' grade of American cottons—the standard of the trade: 'Any cotton expert knows what "middling" American is, just as well as any ordinary man knows what a shilling piece is. Cotton is classed into various grades, fixed authoritatively by experts, and for which type standards exist. The ruling standard is always "middling." There are higher grades, there are lower grades, but the standard is fixed.'

Middling American —the standard.

'Therefore, if a merchant sells a contract for future delivery, say in September or October, for "middling" cotton at a given price, both seller and buyer know perfectly well what they are dealing with.' 'It is a safe contract for both. Such contracts, however, are subject to a clause which guarantees that the seller shall not tender any cotton below the next grade lower than "middling"; he may tender as much higher as he pleases.' If he sells below, 'the buyer, in that case, has full recourse to an arbitration on the samples of the tender.' 'But observe, it must be within the limit of "low middling"; anything lower than this is rejected and a new tender demanded or a penalty exacted.'

CHAPTER III

THE SPECIES, VARIETIES AND RACES OF THE COTTON PLANT

Economic properties.

THE genus GOSSYPIUM belongs to the Natural Order MALVACEÆ, a family of plants closely allied to the STERCULIACEÆ and TILIACEÆ And these three families are not only allied by structural peculiarities but by economic properties. They are, for example, specially rich in fibrous materials, for besides Cotton the MALVACEÆ afford the Silk Cottons, *Bombax* and *Eriodendron*, also several well-known bast fibres, such as that of *Hibiscus cannabinus*—the Deccan hemp—and *Althæa cannabina*—the Hemp-leaved Mallow of Southern Europe; while the TILIACEÆ yield Jute (*Corchorus*), and the allied family, the LINEÆ, embrace the Linseed or Flax (*Linum usitatissimum*). The stems and leaves abound in an emollient mucilage, and the seeds are often rich in oil, *e.g.* linseed and cotton. Thus it will be seen some of the most important of all fibres, as also of the most useful of oils, are derived from the assemblage of plants here briefly indicated.

The MALVACEÆ are essentially tropical plants, and the species accordingly diminish rapidly in number and prevalence as they recede from the Equator. They are also more numerous in the northern tropics of the New than of the Old World. They may be defined as follows:—

Definition of the family.

Herbs, shrubs or trees with soft wood. *Leaves* alternate, simple, entire or lobed, palminerved, often gland-dotted, as also frequently possessed of nectar-yielding glands on certain veins below, and with hairs generally stellate; stipules often conspicuous. *Flowers* usually large, axillary, solitary or clustered, and then forming racemes, corymbs or panicles; nectar-yielding glands often present on the peduncles or on the base of the calyx-tube. *Calyx* embraced by a whorl of bracts called the epicalyx in *Hibiscus* and the bracteoles in *Gossypium*, or absent as in *Sida*, *Abutilon*, &c.; the calyx itself is most frequently, relative to the size of the corolla, an exceptionally small cup which affords so little protection to the fruit as to have necessitated the formation of the protecting bracts. *Corolla* of 5 large petals alternating with the teeth of the calyx-tube, contorted in æstivation and the claws often giving attachment to the base of the

staminal tube (thus simulating a cohesion of the petals) and then inserted hypogynously on the receptacle. *Stamens* many, connate by their filaments into a tube (more or less monadelphous) that completely surrounds the pistil, but is often divided at the top into bundles of anthers that are alternate or opposite to the calyx teeth; anthers reniform, 1-celled, often mature before the flower opens; *pollen-grains* various in size, spherical but mostly echinulate; anthers placed in various positions on the tube, at times on the very apex, or a little below the apex, or near the middle or throughout its length. *Ovary* of several free or connate carpels, whorled around a central axis, often attenuated into a central column; style terminal, united below, free above, bearing the stigmas, that usually correspond in number with the carpels; ovules one or more, inserted on the ventral angle of the carpel, campylotropous or semi-anatropous, sometimes ascending or horizontal with a superior (ventral) raphe, or pendulous with a dorsal raphe. *Fruit* dry, dehiscent, septicidally splitting into cocci which are usually indehiscent, or loculicidally exposing 3–5 septiferous valves, very rarely a fleshy berry. *Seeds* reniform, with firm or crustaceous testa, often wrinkled and sometimes hairy (*Gossypium*, *Fugosia*, *Hibiscus*, *Thespesia*); albumen scanty, mucilaginous; embryo curved; cotyledons foliaceous, folded on each other and in *Gossypium* possessed of imperfectly formed glands, the true gland-dots appearing in the first leaves.

The Order is referred by Bentham and Hooker ('Gen. Pl.' i., 196–9) to four Tribes, as follows:—

Tribes of Malvaceæ.

1. **Malveæ.**—Staminal column antheriferous to the top; styles as many as the cells; carpels separating from the axis; cotyledons foliaceous, folded or contorted—*Althæa*, *Malva*, *Malvastrum*, *Sida*, *Kydia*, *Abutilon*, &c. &c.

2. **Ureneæ.**—Staminal column truncate or toothed, anthers on its outer surface; style branches 10, carpels 5, separating from the axis; cotyledons as in *Malveæ*—*Urena*, *Pavonia*, *Malvaviscus*, &c.

3. **Hibisceæ.**—Staminal column as in *Ureneæ*; styles as many as the cells; carpels loculicidal, persistent; cotyledons of *Malveæ*—*Hibiscus*, *Lagunaria*, *Fugosia* (*Cienfuegosia*), *Thespesia*, *Thurberia*, *Gossypium*, &c.

4. **Bombaceæ.**—Staminal column 5–8 cleft at the top or rarely to the base, more rarely entire; anthers free, reniform or cells adnate, globose, linear, oblong or contorted; style entire or with as many branches as ovarian cells; capsule loculicidal or indehiscent, carpels usually persistent, cotyledons variable. Trees—*Adansonia*, *Bombax*, *Eriodendron*, *Durio*, &c.

GOSSYPIUM, *Linn.*, *Gen. n.* 845.

The plants placed by me under this genus necessitate a slightly more comprehensive interpretation of the assemblage than that ordinarily accepted. Recent research has greatly extended our knowledge of the genus and multiplied the number of species. This almost of necessity involves departures from previous conceptions. It is possible, however, that some forms may have to be excluded and a rearrangement attempted with the following four genera—

Gossypium, *Thurberia*, *Thespesia*, and *Fugosia* (*Cienfuegosia*). I have excluded from *Gossypium* a few of the plants treated by Todaro as *Gossypia*, but it seems possible a further distribution and assortment may be found necessary. Even as it stands the diagnostic characters, usually accepted as denoting *Gossypium*, are by no means of constant application. The following, for example, may be given as indicating the chief points brought out by Bentham and Hooker ('Gen. Pl.' I., 209) and following them by other more recent authors :—

Definition of *Gossypium*.

Bracteoles three, large, cordate. *Calyx* truncate or shortly 5-toothed. Staminal column bearing indefinite filaments, below naked or more rarely with anthers to the actual apex. Ovary 5-locular, loculi with seeds indefinite; style clavate at the apex, with 5 furrows and 5 stigmas. Capsule with loculicidal dehiscence. *Seeds* subglobose or angular, densely woolly or more rarely almost glabrous; albumen thin, membranous or absent; cotyledons strongly folded, with auricles at the base enclosing the upright radicle. Tall herbs or sub-arboreous shrubs. *Leaves* 3-9 lobed or more rarely entire. *Flowers* rather large, yellow or purple. Bracteoles sometimes nigro-punctate, incised, toothed or entire. Cotyledons also sometimes nigro-punctate.

But it may be said that, even with the four genera above named, such diversity exists in *Gossypium* alone as to almost destroy the conceptions on which they have been founded.

Specific Modifications.—Thus, for example, the tendency towards

Bracteoles and Bractlets.

the formation of additional bracteoles (as in *G. Sturtii*); the formation of stipular bractlets (as in *G. vitifolium*, *G. punctatum*, &c.); the existence of bracteoles not only in no way cordate but even provided with distinct claws (as in *G. Stocksii*); the recognition of groups of species in which in the one the bracteoles are entirely free from each other, or in the other united together by their auriculate bases; lastly, the recurrence of quite entire bracteoles. These and such-like extreme manifestations, every now and again met with in the species of *Gossypium*, show the unsatisfactory nature of a distinction based on the bracteoles, when employed to demarcate the genus. It would almost seem as if a safer course would be

Their position.

to regard the position of attachment of the bracteoles as more valuable than their number or shape. Thus, for example, in *G. Sturtii*, *G. drynarioides* and *G. Stocksii* the attachment might be described as upon the calyx-tube and thus above the level of the base of the ovary. In *Thurberia* the bracteoles are certainly not cordate and differ in no respect from those in several plants

here retained in *Gossypium* (e.g. *G. Robinsoni* and *G. Sturtii*). In fact, it would seem probable that cordate bracteoles might with advantage be made to indicate *Gossypium* and non-cordate bracteoles accepted for the allied genera of the HIBISCEÆ. Hochreutiner ('Revis. Gen. *Hibiscus*' in 'Ann. du Conserv. et du Jard. Bot. de Genève,' 1900, pp. 23–191) discusses the variability of the bracts in *Gossypium* and its allied genera in relation to *Hibiscus*.

Calyx. The calyx in *Gossypium* is usually very short and often quite truncate (as in *G. Davidsonii*), though in a good many of the species it is relatively large (as for example in *G. microcarpum*), and the teeth (sepals) conspicuous (as in *G. Sturtii*) and even acuminate or tailed (as in *G. taitense*). It is possible, however, that in the distinctive species of *Fugosia* the calyx is more deeply divided than in *Gossypium*, but it seems questionable how far confidence can be placed in relative characters in the diagnosis of genera.

Ovary. No less unsatisfactory apparently are the distinctions that have been made to depend on the conditions of the ovary and the fruit. It can hardly be in accord with modern experience to view the ovary in *Gossypium* as 5-celled, in *Thurberia* 3-celled, and in *Fugosia* 3 to 4-celled, when one of the most important of all cottons (the Sea Island) has invariably a 3-celled fruit, and another (the Uplands) has the ovary and fruit very commonly 4-celled. Witness also the fact that the ovary is always 3-celled in *G. tomentosum*, *Harknessii*, and *Stocksii*, and 4-celled in *G. Sturtii* and *Davidsonii*. Nor can much dependence be placed on the number of seeds in the cells as indicative of the genus. In *G. drynarioides* the fruit is woody and imperfectly dehiscent, 5-celled, each cell having but one large seed—conditions that might be said to belong to *Thespesia* rather than to *Gossypium*. In *G. Stocksii* there are 2–3 seeds in each cell, in *G. tomentosum* 3–4 seeds, and in *G. Harknessii* 4 seeds. In all the more highly developed cotton-yielding species, the seeds are 7 or more. In fact the increase in number, and decrease in size, might be spoken of as favourable indications from the industrial standpoint.

Number of seeds.

Nature of wool. Far more satisfactory characters can be derived from the nature of the woolly appendage of the seed. With three of the genera mentioned above, the condition prevails of a rust-coloured or golden floss—namely, *Gossypium*, *Fugosia*, and *Thespesia*. Cultivation in *Gossypium* seems to have resulted in this being changed into a white coating. But while in *Fugosia* and *Thespesia* the woolly

cuticular appendage consists of but one fleece, and that practically inseparable (a condition that also prevails with one section of the species of *Gossypium*), by far the most important species of *Gossypium* manifest a further development. One section of these has the wool referable to two coats, an outer removable fleece—the cotton proper—and an inner adherent fleece known as the fuzz. Still another group has a removable floss, but no under fuzz, the seed becoming naked on the separation of the floss. These peculiarities will be found fully expounded (pp. 7, 27, 41, 62), and it is only necessary to allude to them here briefly in order to indicate their possible generic value. It would, in fact, almost seem that the classification of the future may transfer the species that possess a rust-coloured fuzz but no separable floss to other genera, and retain the true floss-bearing forms as constituting the genus *Gossypium*. I have not adopted that course at present for several obvious reasons. A careful study of all the allied genera of Malvaceæ would be essential before justification could be obtained for a radical rearrangement. Moreover, it has often been affirmed that some of the transferable species (such as *G. Stocksii*, *G. tomentosum*, &c.) have been the ancestral stocks of the cultivated cottons. In the present state of our knowledge, therefore, it has appeared to me desirable to retain, as far as possible, the genus as accepted by botanists. But in concluding these observations on the fruit and seed, it may be pointed out that in *Thurberia* the inner wall of the capsule, or rather its partitions, bear a soft white woolly coating, a condition that assumes importance in some of the genera of Bombaceæ, and in these respects, therefore, it is readily isolated from the other genera above reviewed.

Re-arrangement desirable.

Glands.—Much stress has been laid, by certain authors, on the position and nature of the glands. There may be said to be three distinct kinds present:—

Gland-dots.

1. Minute glandular dots (as they are described) more or less imbedded within the tissue of the leaf, bracteole, calyx, corolla and capsule. These have been described by Dr. A. de Bary ('Compar. Anat. of Veget. Organs,' Engl. ed. 1884, pp. 201–10) as intercellular secretory reservoirs. They contain colouring matter, and are by Martinet described as lysigenetic. They are round and filled with a violet colouring matter soluble with difficulty in alcohol. They are, moreover, nearly universally present, though in some species they are often obscured by the tomentum. It would seem, however,

that occasionally the pigment is little if at all developed, while in others it is so pronounced as to originate the description 'nigro-punctate.' In some few species these intercellular glands protrude on the surface of the petioles and peduncles so conspicuously as to almost assume the condition of warts or tubercles and to give a rough or spinose appearance. They are usually more apparent on the petals and capsules than elsewhere, and in the latter case very often rise above the surface. If the fresh petal be placed between clean paper and pressed firmly, the gland-dots will be seen to impart a yellow stain with a purple central spot. Miers (MS. notes) has pointed out that the purple spot is soluble in water, and the yellow stain in alcohol. According to some writers, the presence of the gland-dots on the cotyledons, has been accepted as generic. (Lubbock, 'Seedlings,' I., 1892, pp. 259–60.) These are apparently universally present in *Gossypium*, but are not fully formed. They appear as minute elevations on the surface, but do not sink within the tissue, nor become coloured in the way characteristic of the normal leaves. Lastly, the prevalence of gland-dots in the leaves is more constant with *Gossypium* than with the allied genera, where they are often restricted to the flowers and fruits.

Foliar glands.

2. Glands on the veins of the leaves. The early botanists placed considerable importance on the presence of glands on the midribs (seen on the under-surface) of the leaves of *Gossypia*. Certain species were in fact regarded as distinguished by the absence of such glands, others by the presence of only one gland on the middle vein, while others possessed three or more. There would seem little doubt that a tendency is manifested on the part of the non-cultivated species to preserve a fixed condition in these respects, but that with the cultivated forms variability might be said to become the rule, a consequence either of direct adaptation to environment or a consequence of hybridisation. While, therefore, the presence of glands need not be accepted as diagnostic, they are nevertheless often of value in distinguishing species, their absence being occasionally a more valuable characteristic than their presence. These midrib glands may be elongated and elevated portions of the vein that become pale-coloured or assume a pink tinge, and then rupture lengthwise; or they may be circular or oblong warts which open into distinct pits. In either case they discharge a minute drop of nectar, eagerly sought after by sugar-loving insects.

Nectar-producing glands.

Numerous writers have discussed these foliar glands. Professor William Trelease ('Nectar, Its Nature, Occurrence, and Uses,' published in J. Henry Comstock's 'Report on Cotton Insects,' p. 327) points out that the glands of the leaf begin to secrete when the seedling has about four leaves expanded. He also states that the nectar is most copiously produced during night. Mr. W. Edwin Safford ('Useful Plants of Guam,' published in 'Contrib. United States Nat. Herb.' ix. p. 67) gives a much enlarged microscopic section, showing their formation. Mr. O. F. Cook 'Weevil-Resisting Adaptations, Cotton Plant,' 'United States Dept. Agri. Bull.,' No. 88 of 1906, p. 30) maintains that they have been brought into existence in order to induce friendly insects to visit all parts of the plant. [*Cf.* Darwin, 'Cross and Self Fertilisation,' pp. 403–4; Delpino, 'Rapporti tra insetti e tra nettari estranuziali,' p. 63; Cook, 'United States Dept. Agri. Rep.' No. 78; also 'Bull. Entom.,' No. 49 (1904)].

Extra-floral glands.

3. Extra-floral glands. There may be said to be two sets of glands of this nature—(*a*) three placed on the apex of the peduncle embraced or surrounded by the auriculate bases of the bracteoles, and (*b*) three additional glands placed on the base of the calyx-tube, within and alternate with the bracteoles. These are all more or less circular glands, and usually of a bright yellow or red colour. It will be seen that in the classification of the genus *Gossypium*, adopted by me, I have put some value on the presence or absence of these glands. But as observed, in connection with the foliar nectaries, the constancy of the extra-floral glands can alone be depended on with the non-cultivated species. They secrete a large amount of sweet fluid, which, as Professor Trelease (*l.c.*) and before him Glover ('Agri. Rept.,' 1855, p. 234) have pointed out, forms an attractive food for certain insect visitants. The former author says these glands are not formed on the first few flowers, but that subsequently all possess the outer set, 'though it is not till the cotton has been blooming about a month that the inner set appear.' The evening before the flower unfolds, its glands begin to visibly secrete the nectar.

Stipular glands.

Their Morphology.—With regard to the morphology of these glands it has been commonly supposed that they represent two abortive whorls of bracts. In *Gossypium Stocksii* a pair of minute glands occur on either side of the thickened claw (**Plate No. 6, ff. 4, 5**), and thus are clearly stipular in origin. Mr. Cook has pointed out that the extra-floral glands, in the Guatemalan cotton, are unusually large, the inner

set being protected by minute foliar structures which he calls bractlets. These, he observes, in shape and position, seem to warrant the suggestion that they are in reality the stipules of the bracteoles and do not necessarily correspond with an independent inner (abortive) whorl of bracts. But this seems to leave the glands themselves unaccounted for, so that if they be the representatives of an abortive inner whorl, the bractlets might easily enough be their specially developed stipules. In part support of this opinion the condition in *G. Sturtii* may be again mentioned where a fourth fully-formed bract is often present, above and alternating with the outer whorl. **(See Plate No. 2, ff. 4 and 4a.)**

Bractlets.

But in my studies of *Gossypium* I have come repeatedly across bractlets on species and in regions where no record existed of any destructive insects, against which they could be regarded as directly called into being, such as in Cook's 'Weevil-Resisting Adaptations.' **(See Plate No. 23 C. ×.)** It would thus seem that we may have to seek additional explanations for the presence of the nectaries, the bracteoles and bractlets, than those given in the case of such special cottons as described by Cook. But they are structural peculiarities of great interest to the cotton-grower, and in breeding stock must be carefully considered—both their presence and their absence. [Cf. *G. mexicanum*, p. 241.]

Hairs.

Shape and Texture of Leaves.—Lastly the shape, texture, and degree of hairiness of the leaves have all to be critically studied in the isolation of special varieties and races of cotton. There can be no doubt that too much latitude in description has led to the neglect of forms of great value industrially. Elsewhere I shall endeavour to point out the behaviour of the foliar hairs. It would almost seem as if, in American hybridisation and selection, improvement of staple had accompanied the disappearance of foliar hairs, while, as pointed out by Mr. S. V. Shevade (see Professor Gammie's 'Indian Cottons,' p. 26), an opposite condition might almost be said to have occurred in India—namely, elongation of the seed floss associated with abundance and length of foliar tomentum.

Cultivated and Wild Species.—From the industrial standpoint, the cotton plant is the most important member of the Malvaceæ. When its fibre was first recognised by Europeans as a textile, distinct from linen, hemp, and silk, it was either spoken of under its Indian classical name, *Cárpasa* (*Karpasos* of the Greeks), or its Arabic name *Qutn*, and by botanists was called *Xylon*, *Bombax*, and finally *Gossypium*. Pliny

was the first to use the name *Gossympines* (see p. 11 above) in speaking of the cotton-trees of Tylos, and from that apparently was derived the modern generic name *Gossypium*. The Asiatic (Indian) cotton goods were known to Europe and perhaps China, long before these regions possessed any definite knowledge of the source of the fibre of which they were made. Then followed the African and Arabian cotton and cotton goods, made known chiefly through Egypt, and finally the New World cottons and manufactures discovered by Columbus and his followers and immediate successors. These historic facts almost of necessity involve independent centres of stock, and therefore, in all probability, separate plants. But in addition to the cultivated cottons, there exist a good many species that botanists accept as being *Gossypia* which have never been recorded as seen under cultivation, and indeed yield so little fibre, and that of so inferior a quality, that they are not likely to have been recognised as species of cotton by the early cultivators. So, again, there are met with here and there *Gossypia* that are certainly not cultivated, but may be acclimatised states or ferine conditions of some of the cultivated species.

Independent centres.

Selection.

By giving attention to these indigenous and feral forms, it becomes possible to obtain a fairly accurate conception of the species of *Gossypium*, more especially the conditions that may have existed prior to man's selective influence having modified and blended the useful forms until it has become a matter of great difficulty to distinguish certain species from each other.

Diagnostic Characters.—The most instructive characteristics are derived from the position and condition of the bracteoles; the presence or absence of nectar-yielding glands; and the nature of the floss and fuzz that surround the seed. By a study of these aspects, the species may be referred to five sections that seem almost sub-generic in value, since the species thus brought together are evidently closely related both structurally and geographically. The sections are as follows:—

Sections.

Section I., see pp. 61 to 77.
Section II., see pp. 77 to 163.
Section III., see pp. 163 to 244.
Section IV., see pp. 244 to 315.
Section V., see pp. 316 to 318.

SECTION I.—Species with a Fuzz but no Floss.

BRACTEOLES *quite free, sometimes even clawed, and frequently inserted at different levels on the base of the calyx-tube; rarely possessed of* EXTRA-FLORAL GLANDS (*nectaries*) *on the pedicels, and never within on the calyx;* SEEDS *with distinct and firmly adhering fuzz, but no trace of a true floss.*

Perennial shrubs with the leaves often entire, or only angled or lobed, glabrous, pilose, or tomentose. Wild species (never recorded as met with under cultivation), distributed from the western coast tracts and islands of America to Australia.

ANALYTICAL KEY TO THE SPECIES.

**Leaves pilose, entire or angled, never lobed.*

† Bracteoles entire . . . 1. **G. Sturtii** . (p. 63)

†2 Bracteoles deeply incised:

(*a*) Leaves often almost glabrous . . . 2. **G. Davidsonii** . (p. 65)

(*b*) Leaves tomentose . 3. **G. Klotzschianum** (p. 66)

***Leaves usually thin and softly hairy, 3-lobed, the lobes elongated, spreading.*

† Bracteoles entire, ovate acute mucronate . . . 4. **G. Robinsoni** . (p. 67)

†2 Bracteoles thin, incised, ovate cordate, teeth awl-shaped 5. **G. Darwinii** . (p. 68)

†3 Bracteoles thick, toothed, oblong acute cordate . . 6. **G. tomentosum** . (p. 69)

****Leaves leathery, often almost glabrous, 3 to 5 or 7-lobed, the lobes rounded and palmately radiating.*

† Bracteoles, subcordate, broad ovate, very large, accrescent and strongly reticulated . . . . 7. **G. drynarioides** (p. 71)

†2 Bracteoles entire, ovate, not cordate but acuminate . 8. **G. Harknessii** . (p. 73)

†3 Bracteoles toothed, clawed, ovate, oblong . . . 9. **G. Stocksii** . (p. 73)

Wild species.

Sectional Peculiarities.—Into this section I have thrown the species of *Gossypium* that have perfectly free bracteoles, that possess practically no trace of extra-floral nectaries, and that have seeds with a short fuzz but no true floss. They are all wild plants, or at all events species of which no record exists of their ever having been systematically cultivated. The fruits are moreover so small, the seeds relatively so large, and the fuzz so absolutely worthless (from the industrial standpoint) that the observation becomes justified that unless as ornamental shrubs they are not likely to have ever been cultivated.

Woolly coating.

In Chapter II., which deals with *The Cotton Fibre*, it will be found (pp. 7, 27, 41, 56) I have suggested four groups of wild cottons based on the condition and nature of the woolly coating. The present section of the genus corresponds with the third of these groups of fleeces, and it will thus be seen that we are justified in regarding the peculiarities of the woolly coating of the seed as of specific if not sub-generic value. Since met with in wild cottons they are certainly not acquired characters, assumed in response to man's requirements. Although the variation and adaptation incident to cultivation and to altered environment would doubtless change these peculiarities in certain directions, it may be anticipated that the members of each of the sections adopted by me would move as it were along parallel lines. Assuming that they constitute natural sections, the species may be expected to preserve their relationship to each other tenaciously and to only depart from that association under the influence of hybridisation. Moreover they will be found to cross more freely with each other than with members of other sections. It would therefore seem highly probable that to this circumstance may be due the observation, sometimes recorded, that hybridisation between cottons is impossible, and at other times the very opposite opinion having been advanced—namely, that it is impossible to prevent cross-breeding when two or more cottons are grown in proximity. In the one case the hybridisation of remote species—members of different groups—may have been attempted, in the other the crossing of closely allied species or varieties of one species—or at all events members of the same group—may have been considered. The hybridisation of the species of two sections would not, however, seem impossible though often difficult, and certain advances or stages may have to be accomplished before the desired final result can be attained.

Hybridisation.

Pollen-grains.

The isolation of the cottons into distinctive groups is supported

M. Smith delt, J. N. Fitch lith. West, Newman imp.

No. 2. GOSSYPIUM STURTII, *F. v. M.*

1, Flowering shoot; 2 and 3, calyx; 4 and 4a, supplementary bracteole and calyx; 5, seed (natural size and much enlarged); 6, leaf showing form of gland; and 7, claw of petal with its ciliate margin.

by other circumstances than the nature of their flosses. In Chapter IV., for example (pp.343–50), it will be seen that I endeavour to show that the pollen-grains of the species and varieties of *Gossypium* would seem to manifest certain characteristics that might almost be utilised in systematic descriptions. The members of the present group support the opinion that they are all wild plants by one and all of them exemplifying the fairly constant rule of each having a distinctive pollen-grain of its own, and by none of them apparently possessing more than one form of grain.

Cotton area.

Distribution.—The geographical distribution of this assemblage of cottons is very striking. Starting from Lower California and Cerros Islands (28° north latitude) they are carried south-west to Hawaii (20° north) and south to the Galápagos Islands (on the Equator) and still south-west to Australia, where two species are distributed from 15° to 30° south latitude (namely in Western, Southern, Central Australia and Queensland). Lastly, one outlying species occurs in India (Sind) and across the Persian Gulf in Arabia (Dhofar) about 25° north latitude. They are not only structurally a remarkably distinct group of cottons, but might be characterised as confined to certain islands and coast lands of the Pacific Ocean. No member of the group has hitherto been recorded as met with in America proper, still less as having crossed that continent to the islands and coast lands of the Atlantic. Thus in every respect they stand by themselves and are probably quite unconnected with any cultivated cottons. Many of them closely approximate to the plants placed in the genera *Fuyosia* (*Cienfuegosia*) and *Thurberia* on the one hand and to those in *Thespesia* on the other. Indeed Todaro described as species of *Gossypium* several plants (such as *Gossypium anomalum*) now universally accepted as species of *Cienfuegosia*; and Mr. J. Miers, who devoted much attention to the cottons, proposed the name *G. lanceæforme* (See 'Jour. Bot.' xxxi. 330) for a specimen in the British Museum which I find to be *Thurberia thespesioides*, *A. Gray*. The members of the present group of *Gossypium* thus stand on the borderland, structurally and geographically, of the cottons proper.

Allied genera.

1. **G. STURTII**, ***F. v. M.***, *Frag. Phyt. Austr.* III., 6 (1863), *et* VI., 169, 251, *et* IX., 127; *Benth. and Mueller, Fl. Austr. vol.* I., 222; *STURTIA GOSSYPIOIDES, R. Br., Sturt., Exp. Cent. Austr.* II., *app.* 68; *G. STURTII, F. v.M. Parl., Sp. Cot. p.* 62 (*sp. excl.*); *G. AUSTRALIENSE, Tod., Oss. Cot.* (1863), *p.* 19; *G. STURTII,*

F.v.M. Tod., Relaz. Cult. dei Cot. 117; *Moore and Betche, Handbook Fl. New S.W. p.* 61; *Maiden, Useful Native Plants of Australia,* 1889, p. 131; *CIENFUEGOSIA GOSSIPIOIDES. Hochr., Ann. du Conserv. du Jard. Bot. de Genève* 1902, *p.* 56; *Aliotta, Rivis. Crit. Gen. Goss.,* 1903, *p.* 99 (*sp. excl.*).

Description.

A glabrous shrub, prominently warted. Leaves ovate-deltoid, apiculate, quite entire, veins eglandular, but often splitting lengthwise (**f. 6**); stipules minute, caducous; bracteoles 3, ovate oblong, cordate, apiculate or bristle-tipped, entire, quite free from each other (**f. 3**), shortly clawed, inserted at different levels, and sometimes furnished with a supplementary bracteole within and above the others and attached to the calyx-tube (**ff. 4 and 4a**); calyx campanulate, smooth, with 5 large triangular acute mucronate teeth, each having 3 veins (**ff. 2, 3 and 4**); seeds ovate acute truncate below, coated with very short closely adherent rusty wool not separable into two coats (**f. 5**). **(See Plate No. 2, ff. 1–7.)**

This is a striking and highly ornamental species, yet it does not appear to have ever been cultivated, and in consequence has not in any way contributed to the long series of floss-yielding races. It is a shrub quite glabrous in all its parts, except the outer surface of the corolla. Twigs round, smooth, purplish, prominently gland-dotted. *Leaves* coriaceous, glaucous, smooth, prominently reticulated both above and below, ovate deltoid, very minutely cordate, acute apiculate, quite entire but 3–5 veined, eglandular, about 1 to 1½ inches long, and a little less in breadth; petiole usually retained in an ascending attitude, a little longer than the blade and strongly gland-dotted. *Stipules* narrow linear lanceolate, caducous. *Inflorescence* in the form of ascending lateral leaf and flower-bearing shoots (f. 1) that assume a corymbose condition, so that the flowers are never truly axillary, individual flower-stalks about an inch long, angled through a prolongation from the base of the bracteoles. *Bracteoles* 3, thick, smooth, glabrous, ovate oblong cordate, quite entire, acute apiculate or beaked, 7 to 9 veined, quite free from each other and shortly clawed. attachment variable, often on the calyx-tube. *Flowers* medium-sized, rose-purple with large dark spots; *corolla* with short well-formed claws, woolly on the margins (f. 7) as also on half of the outer surface, distinctly gland-dotted; *calyx* smooth quite glabrous, gland-dotted, campanulate, with five large well-formed triangular teeth that end in stout mucros, veins three to each sepal, arching up towards and conniving in the sharp rigid beak. *Pollen-grains* of medium size, having a thick wall of two distinct layers and coarse linear obtuse hyaline spines that do not seem to arise from tubercles. **(See Plate No. 53 f. 4.)** *Fruit* ovate-rotund acute, shortly apiculate, embraced and enclosed by the persistent bracteoles, gland-dotted, 4-celled; *seeds* 5 in each cell, ovate acute truncate at the lower end, coated with very short closely adherent rusty wool that shows no tendency to separate into two layers or coats corresponding to the floss and fuzz of the cultivated species.

M. Smith delt, J. N. Fitch lith.

West, Newman imp.

No. 3. GOSSYPIUM DAVIDSONII, *KILLOGG.*

1, Flowering shoot; 2, portion of leaf showing hairs and gland; 3, bud with calyx and portion of bracteoles; 4, free bracteole; 5, ripe four-celled fruit; 6, enlarged seed, showing crumpled floss; 7 and 8, seed, natural size, showing raphe and floss.

The peculiarity of occasionally forming a supplementary bracteole, directly attached to the base of the calyx (f. 4), does not appear to have been described previously. It is suggestive of a second whorl of bracteoles of which as a rule only one seems to be formed. Unlike the minute bractlets described by Cook, and which he believes are formed to protect the glands, the structure seen in this plant is of the same form and size as the other bracteoles, is in fact a fourth bracteole within and alternating with the others, and there are no glands present for it to protect.

Habitat.—This tall very ornamental wild shrub was originally collected during the McDougal Sturt journey to the interior of Australia in 1839. It has since been found in many other parts of that country, such as in the vicinity of Lake Eyre, Mt. Watson, Central South Australia (Gosse's Exped.) towards Spencer's Gulf, Warburton, Mt. Lyndhurst, &c., &c. It would, however, seem to be confined to Australia. Australia.

Citation of Specimens.—There are admirable examples of this species in the Herbaria of Kew Gardens, the British Museum, Edinburgh, &c.:— McDougal Sturt's specimen n. 235 coll. in 1839; Beckler, n. 1, 1861; Gosse's Exped. Comm. R. Schomburgk, 1874, n. 239; Elder Exped. Comm. 1891, collected R. Helms; Lake Eyre, coll. Mr. Andrews 1875 n. 81; Lyndhurst coll. Max Koch, 1899, n. 12. In the Br. Mus.:— Baron F. von Mueller, 1862, 'D. Sturt's n. 20, found in the beds of the creeks of Barrier Range.' Specimens.

2. G. DAVIDSONII, ***Kelogg,*** *Proc. Calif. Acad. Scien.* (1873), *vol.* v., 82–3; *Brewer and Watson, Bot. California* (1876), *vol* i., 82.

Leaves ovate cordate suddenly acuminate, occasionally 3-angled on upper half, minutely stellately hairy or sub-glabrous. Description.

I have grave doubt as to this being specifically distinct from *G. Klotzschianum.* I leave it here more on account of its geographical position than anything else. The material seen by me is more satisfactory than with the undoubted samples of Andersson's species. I accordingly give a more detailed description than hitherto published, especially of the fruit and seed (**see Plate No. 3, ff. 1–8**).

Stems round, bright red, wrinkled, glabrous below, cinereous, and very minutely hairy above. *Leaves* $2\frac{1}{2} \times 2$ inches broad, ovate cordate, suddenly acute (poplar-like), quite entire (never lobed), but sometimes showing a tendency to be three-angled on upper half; 5-nerved the central one only with a minute gland near the base (f. 2), minutely stellately hairy, especially on the veins, pale-coloured below; *petiole* nearly as long as the blade, where it becomes thickened and glandular; *stipules* very minute linear

acuminate, caducous. *Inflorescence* short axillary shoots, one to three flowered, much longer than the subtended leaf (f. 1), peduncle 2 to 3 inches long, pedicels 1 inch, sub-glandular within the horseshoe-like attachment of the bracteoles (f. 3); *bracteoles* ovate sub-rotund cordate, quite free from each other, glands not visible within, membranous, turning red-brown, accrescent, woolly, especially on the long, narrow, almost tailed teeth. *Flowers* medium-sized, bright yellow with purple claws, woolly on the margins; *calyx* open, loose, campanulate, devoid of any trace of teeth, many-veined with rows of glands and a very few hairs on the veins (f. 3). *Fruits* ovate rotund acute, shorter than the bracteoles, 4-celled (f. 5); *seeds* large, free, flattened on the face and with on this a strongly marked oblique line (raphe) (f. 8), rounded otherwise and only slightly pointed below, sparsely coated with an exceedingly short ($\frac{1}{8}$ to $\frac{1}{4}$ inch long), minutely crumpled and closely compacted, golden-coloured floss (f. 6), not referable to two layers (f. 7).

California. *Habitat.* — Lower California, and, according to Brewer and Watson (*l.c.*), in Cerros Island as well.

Specimens. *Citation of Specimens.*—Collected by Hinds (1841) at Magdalena Bay, Lower California; and by Barclay also in California, n. 3084; said to be a shrub 3 feet high found in ravines, Magdalena Bay.

In the Kew and British Museum Herbaria there are specimens collected by Dr. Edward Palmer (1887), in Guaymas, Mexico, n. 244, of a plant, possibly a distinct species, though closely allied to this, in which the bracteoles are much smaller, and the leaves often 3-toothed on the apex and almost quite glabrous.

3. G. KLOTZSCHIANUM, *Anders., Enum. Pl. Insul. Galápag. in Kongl. Vet. Akad. Handl.* (1853), *vol.* LXXIV., 228; *Walp., Ann. Bot.* IV., 309; *Robinson, Fl. Galáp. Is.* (1902) (*in Proc. Am. Ac. Arts*, XXXVIII., *Contr. from Gray Herb.* 24, 174).

Description. Leaves rotund-cordate acuminate, entire, tomentose, with adpressed hairs and pale coloured, one gland near the base of the central nerve below; bracteoles quite free, broad ovate cordate, deeply laciniate into 10–12 long narrow teeth, with prominent veins, especially when young.

A shrub twice the height of a man, having long spreading branches, the twigs smooth, reddish brown, and minutely tomentose or velvety when young. *Leaves* $2\frac{1}{2}$ inches long by 2 inches broad, cinereously tomentose, gland dottings very obscure, stellately pubescent, especially below. *Inflorescence* axillary, lateral shoots with peduncle twice the length of the subtended petiole, one to three flowered; *bracteoles* softly tomentose, broad, deeply auriculate, scarcely ovate, the apex being rounded and deeply laciniate, no glands on the pedicel nor within the bracteoles; pedicels about 1 inch long, angled and furrowed. *Flowers* fairly large, $1\frac{1}{2}$ inches broad, one-third exceeding the bracteoles in length, rotating to left; *corolla* pale

yellow, wide convolvulate, not having purple claws; *calyx* cut almost square across or with 5 shallow undulations. Fruit and seed not seen by me, and not described by the original author nor by subsequent writers.

Habitat.—Found on stony places in the lower sterile regions of the Islands of Chatham and Charles, Galápagos. Galápagos.

Citation of Specimens.—Andersson's n. 173, seen both in Kew and Geneva Herbaria; also Captain Wood's specimen. Specimens.

The plant was named in honour of Dr. Fr. Klotzsch, of whom Andersson speaks in high praise for his knowledge of the flora of these islands.

Nomenclature.—A specimen which, through the kindness of M. Casimir de Candolle of Geneva, I have had the pleasure to inspect, bears on the attached label (in Andersson's handwriting apparently) the name '*G. purpurascens, Poir., var. Klotzschianum.*'

I am, however, by no means satisfied that all the specimens that have been attributed to *G. Klotzschianum* in reality belong to it. With better material it seems possible there may be at least two additional species. I propose, accordingly, to establish one—*G. Darwinii*—but the present plant is, as already pointed out, closely allied to a *Gossypium* found in California, which may prove a third member of the assemblage. The plants indicated, however, would hardly differ more from each other than might be expected, from the antiquity of the separation of the islands from the mainland, and would be but another example of a condition pointed out by Hooker and other writers on the plants and animals of the Galápagos (cf. 'Island Life,' A. R. Wallace, 1892, 287–91). Ancient islands.

4. G. ROBINSONI, ***F. v. M.,*** *Frag. Phyt. Austr.* IX., 126; *Tod., Relaz. Cult. dei Cot.* 113 *t.* X. *f.* 1; *CIENFUEGOSIA ROBINSONI, Hochr., Ann. Conserv. et du Jard. Bot. de Genève,* 1902, 57.

Young shoots quite glabrous; leaves ovate-oblong acute to deeply three-lobed; bracteoles ovate-oblong, entire, acute-mucronate, tapering below. Description.

Shoots glabrous, round, smooth, gland-dotted. *Leaves* entire or palmately 3-lobed, the segmentation carried for more than half the breadth of the leaf and the lobes linear oblong, prominently gland-dotted; *petioles* a little longer than the leaves, 1½ to 2½ inches in length, thin, ascending; *stipules* minute, caducous. *Inflorescence* on special flowering shoots, 2½ to 3½ inches long, terminated by two or three leaves and one or at most two flowers; *bracteoles* ovate oblong acute, entire, tapering below, and quite free from each other or occasionally somewhat united near their attachment. *Corolla* yellow with pinkish flush and purple spots on the claws, tube short, limbs

spreading, claws with strong woolly margins, outer surface of petal also tomentose. *Calyx* wide campanulate, smooth, glabrous, gland-dotted, teeth five, short, deltoid acute, 10-veined, one to each sepal and one between. *Fruit* and *seed* not seen.

Western Australia.

Habitat.—An imperfectly known but undoubted wild species found in Western Australia.

Citation of Specimens.—Only one seen by me, and that contributed by the late Sir Ferdinand Baron von Müeller. It in many respects resembles *Thurberia* or *Cienfuegosia*.

5. **G. DARWINII**, *sp. nov.* : *G. PURPURASCENS, Hook. f., Linn., Soc. Trans.* xx., 1847, 231 ; *G. KLOTZSCHIANUM, Robinson and Green, Contr. Gray Herb. No.* 9, 145 ; *G. BARBADENSE, Robinson, Fl. Galáp. Isl.* (*in part*) *Am. Ac. Arts, Contr. from Gray Herb. No.* 24, 173.

Description.

Leaves softly and minutely stellately tomentose, especially below, deeply 3-foliate, scarcely cordate, gland obscure on middle vein; bracteoles ovate cordate, teeth suddenly acuminate, awl-shaped, and hooked (**see Plate No. 4**).

This appears to be a perennial shrub. Branches strongly angled, dark purple, above minutely woolly. *Leaves* $3\frac{1}{2} \times 2\frac{1}{2}$ inches, softly tomentose when young, less so with age, prominently gland-dotted (the glands often large and surrounded with a coloured ring within the tissue), central lobe much the longest, linear oblong acuminate, with the sinuses on either side thrown up in folds, veins prominently woolly, petioles 1 to $1\frac{1}{2}$ inches long, thickened upwards, slightly woolly near the apex and sparsely warted below. *Inflorescence* axillary, flowers solitary, on short rigid pedicles; *bracteoles* quite free, not possessed of extra-floral glands (nectaries), ovate cordate, cut into many very narrow awl-shaped teeth that become almost hooked, at first softly tomentose then accrescent and glabrescent, membranous, prominently reticulated, completely enclosing the fruit. *Flowers* very large, wide spreading, yellow, with purple hairy claws to the petals; *calyx* undulate or cut square across (**f. 2**). Ripe fruit and seed not seen by me, but the pollen-grains are distinctive (**see Plate No. 53, f. 3**).

Galápagos.

Habitat.—James and Chatham Islands, Galápagos.

Specimens.

Citation of Specimens.—In the Cambridge University Herbarium there is preserved the sample of *Gossypium* collected in 1835 by Mr. Charles Darwin, during the voyage of the 'Beagle,' at James Island, Galápagos. This was named *G. purpurascens, Poir.*, but, I venture to think, incorrectly. It is a perfectly good new species which has since been twice re-collected at the Galápagos. In Kew there are two sheets of this interesting plant collected by Dr. Habel during the expedition of the 'Indefatigable' in 1868; the other collected by Dr. G. Bauer (n. 22) in the south-west end of Chatham Island, during June 1891 (*ex* Herb. A. Gray).

M. Smith delt, J. N. Fitch lith.

West, Newman imp.

No. 4. GOSSYPIUM DARWINII, *WATT.*

1, Flowering shoot; 2, bud and calyx showing absence of glands.

Nomenclature.—The observations offered under *G. Davidsonii* and *G. Klotzschianum* regarding the cottons of the Galápagos Islands receive renewed interest through the discovery, in herbaria, of material sufficient to justify the separation of the present plant. Unlike the other species named, the leaves, instead of being entire, are, in the new species, deeply 3-foliate and the bracteoles broad ovate cordate, deeply laciniate—characters that ally it much more closely with *G. vitifolium* than with *G. Klotzschianum.* Unfortunately I have not seen the fruit, and it is thus probable that it may have to be removed from the present group and placed nearer to the cultivated cottons of America, in which case it would become of even greater interest than at present, since it might then be regarded as denoting a condition that may have prevailed prior to man's influence on the genus. At the time at which this species was collected by Darwin ('Voyage of the Beagle,' 1831–6) cotton could hardly have been cultivated anywhere on the Galápagos Islands, and *G. Darwinii* may accordingly be the survival of an ancient form that may at one time have had a wide distribution on the mainland of America. In part support of this suggestion I would draw attention to the fact that the seeds of *G. Davidsonii* have a very short but separable floss rather than a fuzz, and its pollen grains approximate in size and shape more closely to those of *G. vitifolium* and *G. barbadense* than to those of any of the members of the present section of the genus.

Possibly an early type.

Man's influence.

6. G. TOMENTOSUM, *Nutt., Seem., Fl. Vit.* (1865), 22; *G. RELIGIOSUM, A. Gray in Bot. Explor. Exped. under Wilkes* (*pub.* 1854), 179; *G. TOMENTOSUM, Hillebrand, Fl. Hawaiian Islands,* 50; *Todaro, Relaz. Cult. dei Cot.* (1877), 126; *G. SANDWICENSE, Parl., Sp. Cot.* (1866), 37, *t.* VI., *f.* B.

Mao or Hulu-hulu cotton of Hawaii.

A subscandent shrub, all parts coated with hoary short tomentum; leaves thick, cordate, 3-(sometimes 5-) palmatifid, lobes ovate deltoid acute and apiculate, veins thick, prominent, eglandular, stipules minute, very caducous (**f. 2**); bracteoles small, thick, tomentose on both surfaces, toothed, ovate-oblong acute, slightly cordate, but not clawed (**f. 5**); calyx tomentose, large, loose, with ten veins (**ff. 3 and 4**); fruit very small, hardly more than twice the length of calyx (**ff. 5 and 6**); seeds large, irregular, densely coated with a dark rusty wool not referable to two layers (**f. 7**). (**See Plate No. 5, ff. 1–7.**)

Description.

It is a shrub 4 to 6 feet in height, uniformly and completely coated with short hoary tomentum to such an extent as to almost cover up the black gland-dots with which it is profusely besprinkled, but it is quite devoid of the long villous hairs so commonly seen in this genus. *Leaves* thick, leathery, measuring 1½ to 3 inches each way, or only just a little broader than the length of the petiole, less than half segmented into 3 (sometimes 5) lobes, base deeply cordate, lobes not constricted below, veins 5 thick, prominent, very woolly. *Inflorescence* axillary, solitary, flowers on simple, thick, angled peduncles (f. 1), (considerably shorter than the petioles), or, near the extremity of the shoots, the flowers may be borne on short leafy twigs, ½ to 1 inch long; *bracteoles* thick, tomentose on both surfaces, all equal in size and free from each other, but not clawed nor possessed of extra-floral glands, ovate-oblong, slightly cordate acute 9 to 11 toothed and veined, persistent on the fruit, but hardly accrescent. *Flowers* about 1½ inches long, sulphur yellow; *corolla* wide open, tomentose along the outer margin and both on the outer and inner surfaces; *calyx* tomentose, large, loose, nigro-punctate, 10-veined, truncate or with 5 short crenate teeth, accrescent and, though ruptured with the growth of the fruit, remains embracing the lower half. *Fruit* very small, ovate-oblong, beaked (but not so prominently as shown by Parlatore in his *G. sandwicense*), rough and gland pitted on the outer surface, 3-4-celled and with 3-4 seeds in each cell; *seeds* relatively very large, irregular in shape, densely and profusely coated with short dark rusty wool, not referable to two layers (corresponding to the fuzz and floss of many cultured cottons).

Hawaii.

Habitat.—This wild plant has apparently never been cultivated. It is indigenous to the Sandwich or Hawaiian Islands, and has by mistake only been assigned to the Fiji Islands through its being confused with *G. religiosum*, by Solander.

Citation of Specimens.—There are admirable examples of this plant in the Kew, British Museum, Edinburgh and Geneva Herbaria. It is met with usually along the coast, and is called *Mao* or *Hulu-hulu*. The most notable examples examined by me are:—Sandwich Islands: Mowee in 1825, specimen coll. by McRae; Oahu, 1865, by Hillebrand, n. 368; Mrs. Sinclair's specimen, comm. to Kew in 1885 also her MS. drawing in Kew Library (in which the calyx is truncate). There are in addition to these the following specimens in the British Museum:—'Owhyhee,' Nuttall's type specimen; Menzies and D. Nelson; and Mann and Brigham, n. 228, Oahu. In the Cambridge Herbarium there is a specimen collected by McRae at Karankua Bay, 'Owhyhee,' in 1825. In the Economic Herbarium of the United States' Dept. of Agriculture, a specimen raised at Washington from seed supplied by J. G. Smith from Honolulu.

Nomenclature.—Seemann was in error when he associated his specimen n. 28, collected on the Rakiraki coast, Kadava, Fiji Islands, with Nuttall's Sandwich Island species. As he very rightly observes, his Fiji plant is *G. religiosum, Roxb.* (a form of *G. hirsutum, Linn.*, 'Sp. Pl.'), but it has nothing whatever to do with *G. tomentosum, Nutt.*

M. Smith delt. J. N. Fitch lith. West, Newman imp.

No. 5. GOSSYPIUM TOMENTOSUM, *NUTT.*

1, Flowering shoot; 2, young hairy leaf showing stipules; 3 and 4, bud showing calyx, bracteoles removed—no glands; 5 and 6, ripe fruits; 7, fuzzy seed with floss.

This mistake has been repeated by many subsequent writers, and although Hillebrand upholds *G. tomentosum* as a good species and amplifies and corrects the original description, he has not himself clearly and definitely separated it from *G. taitense, Parl.*, which he calls *G. religiosum, Linn.* This is the more surprising since he observes that *G. tomentosum* is unfit for cultivation on account of its short staple, while even the wild *G. taitense* affords a fairly good floss which in the cultivated state (*G. purpurascens*) affords the Bourbon cotton. Fiji cottons.

It is somewhat significant that Parlatore, while relegating *G. tomentosum* to the position of a doubtful species, should have figured and described the Sandwich Island plant as a new form, under the name *G. sandwicense*, and thus failed to recognise that his supposed new species was unquestionably Nuttall's plant. It is curious also that, while Seemann says cotton is not indigenous to any part of the Fiji Islands, he should have allowed the association of *G. tomentosum* with these islands. This circumstance is doubtless explained by the confusion of *G. tomentosum, Nutt.*, with *G. taitense, Parl.* Sandwich Islands.

Var. parvifolia:—In the British Museum there is a specimen with very small leaves, entire or three-lobed, which bears the remark that it is, *G. parvifolium, Nutt. MS.* It certainly is nothing more than a variety, but it is worthy of separate mention. It would appear to have been collected at Owhyhee. A specimen in the Kew Herbarium from the Molokai Island has the leaves very much narrower than is customary and is thus probably also this variety of the species.

7. **G. DRYNARIOIDES**, *Seem., Fl. Vit.* 1865, p. 22; *Hillebrand, Fl. Hawaiian Islands*, 1888, 51; *Todaro, Relaz. Cult. dei Cot.* 1877, 248.

Kokio cotton of Hawaii.

Leaves cordate, 5–7-lobed, very large; flowers solitary on jointed peduncles, with an entire bract-like leaf; bracteoles adnate to the calyx-tube, entire or toothed and free from each other, becoming very large, membranous, and strongly reticulate; calyx urceolate, completely enclosing the young flower; seeds solitary in the cells, very large, and with a single coarse brownish tomentum. Description.

A small tree, 12–15 feet high with a thick gnarled trunk; *leaves* membranous, glabrous, pitted, but destitute of black dots, cordate, 7–5-lobed, about 5 inches in diameter, lobes comparatively very short, deltoid (eglandular?), petioles 3–4 inches long. *Inflorescence* solitary, axillary flowers within the uppermost leaves, the peduncles being jointed and bearing a broad

sessile, oblique bract near the middle; *bracteoles* glabrous, thick, leathery broad ovate to sub-cordate, obtuse, entire or serrate, 7–13 nerved, when young ovate acute, quite free and entire, about 1 inch long, but as the flower matures they continue to grow until they often become 2 inches long and 1 inch broad. *Flowers* large, somewhat trumpet-shaped, and brick-red; *calyx* urceolate, truncate, distinctly punctate with black dots; *petals* obovate-oblong, entire, 3-4 inches long, silky outside, prominently reticulated and with black dots within meshes. *Pollen-grains* very large and possessing a distinctive palisade exine, bearing long, linear, blunt spines (see Plate No. 53, f. 1); *ovary* 5-celled, each cell with one ascending ovule; *capsule* ovoid, thick, woody, opening tardily near the apex; *seeds* obovoid, covered with a short brownish tomentum.

Var. β.—Bracts of involucre lanceolate, 1½ to 2 inches, and ½ to 1 inch broad.

Hawaii.

Habitat.—Originally collected by Nelson (the companion of Captain Cook) in the Hawaii Islands. Re-discovered by Mr. R. Meyer, three trees only being seen in the western end of Molakai, which, however, could not be again found when looked for a few years later. It bears the vernacular name of *kokio*. The variety, Hillebrand explains, was found in the eastern end of Oahu, on the hills of Makaku and Koko Head. Two trees only were seen.

Citation of Specimens.—I have seen no specimen of the variety in any of the Herbaria examined by me. The typical form is represented both in the Kew and British Museum Herbaria. The plant, needless to say, never has in any way contributed to the production of the commercial cottons of the world—it is purely and simply a wild plant, and apparently a very rare one.

Nomenclature. — The above diagnostic characters have been abstracted mainly from Hillebrand, amplified here and there through personal inspection of specimens. Seemann explains that the name was suggested through the resemblance of the accrescent bracteoles to the basal fronds of *Drynaria*. Hillebrand observes that the species is remarkable in the genus for its bracts, red flowers, a woody capsule, and single shortly tomentose seed. Most of these special characteristics are, however, by no means confined to the present species, but occur in several other members of the present section of the genus. Perhaps of even greater importance is the position of the bracteoles, high up on the calyx-tube. In this respect it recalls the East Tropical African

Thespesia.

Thespesia Danis, Oliver, ('Hook. Ic. Pl.' xiv. t. 1336) and the Philippine Island *T. campylosiphon, Rolfe*, ('Jour. Linn. Soc.' xxi., 308). The suggestion may in fact be ventured that it is possible all three may be found to constitute a new genus. In some aspects they

bring to mind the species of *Dicellostyles* as well as of certain *Thespesia*. I retain *G. drynarioides* in its present position in deference to Hillebrand, who has studied it with fresh material before him and with Seemann's opinion doubtless duly considered—viz. that he hesitated about the genus into which it should be placed.

8 G. HARKNESSII, ***Brandg.***, *Pl. of Baja Calif., in Calif. Acad. Science, 2nd Series, vol.* II. 136–7.

Description.

Leaves small, ivy-like, thick, quite glabrous, faintly 3-lobed; bracteoles broadly ovate-acuminate, entire.

Twigs round, woody, with firm red bark, wrinkled on drying, glabrous, but when young, shoots, as also the petioles, prominently gland-dotted. *Leaves* thick, leathery, quite glabrous, prominently reticulated, 1½ inches, ovate-rotund cordate, angled or faintly 3-lobed, ears at the base almost closing the sinus; *petiole* an inch or more long and equalling the length of the blade. *Bracteoles* free, broadly ovate-acuminate, entire, less than half the length of the corolla, apparently caducous as the fruit ripens. *Flowers* sulphur-yellow in colour, twice the length of the bracteoles; *petals* with purple spots at the base; *calyx* truncate, persistent, but ruptured by the fruit, glabrous, many-veined, prominently gland-dotted. *Fruit* ovate-rotund, only slightly pointed; *cells* 3, with 4 seeds in each; *seeds* semi-adherent together, woolly coating exceedingly short and not separable into two layers or coats (see Plate No. 4).

California.

Habitat.—This somewhat remarkable wild plant is found on Santa Margarita Island of California (T. S. Brandegee), and has apparently also been collected by Dr. Edward Palmer, n. 838, in Carmen Island, Mexico. In the former locality it was found as a rounded, dense shrub, growing in masses. It attains a height of 2–3 feet.

Nomenclature.—It has its nearest affinity to *G. Stocksii*, but is also suggestive of *G. obtusifolium* and of some of the forms of African and Indian cultivated cottons, usually spoken of as Asiatic races, but so far as is known the present plant has never been cultivated nor employed in crossing to produce special staple-yielding stocks, and is an undoubted wild species that in some respects resembles *Cienfuegosia Gerrardii*, *Hochr.*

9. G. STOCKSII, ***M. Mast.***, *Fl. Br. Ind.* I. (1874) 346; *Cooke, Fl. Bomb. Pres.* I. 115; *Talbot, Trees, Shrubs, &c. Bomb. Pres. 2nd ed.* (1902), 38; *G. HERBACEUM, Tod. (in part), Relaz. Cult.*

dei Cot., 132 ; *G. OBTUSIFOLIUM*, *Stocks* (*non. Roxb.*), *MS. name in Herb. Kew ; Royle, Cotton in India*, 1851, 144 ; *Dalz. & Gib., Bomb. Fl.*, 21 ; *G. HERBACEUM*, *Aliotta, Rev. Crit. Gen. Goss.* 1903 *(in part)*, 70, 104 ; *Gammie, The Indian Cottons*, 1905, 2.

Sind (Karachi) and Dhofar Wild Cottons.

Description.

Perennial shrub ; leaves thick, leathery, matted with stellate hairs, deeply cordate, with 5, more rarely 3, obtuse (almost rounded) mucronate lobes, or still more rarely simple (**ff. 1 and 3**) ; veins eglandular ; bracteoles quite free, clawed and attached to the bottom of the calyx-tube, ovate oblong, deeply gashed (**ff. 4 and 5**) ; calyx tomentose, campanulate, prominently 5-toothed, rounded and bristle-tipped, also 15-veined (**ff. 5 and 2**) ; seeds closely compacted together, but not united (**ff. 7 and 8**), coated with a rich golden fuzz not referable to two layers (**f. 9**), though after being torn away the surface of the seed seems as if felted with a minute wool. (**See Plate No. 6.**)

A small perennial, tufted or much branched, woody shrub, with thin straight, round, sub-glabrous, and almost non-gland-dotted woody branches. *Leaves* usually not more than 1 inch each way, deeply cordate and auricled, one half segmented into 5, more rarely 3 lobes, or simple ; when young, the twigs, leaves, and inflorescences are of a greyish-green colour, owing to being matted with stellate hairs (less so with maturity), lobes ovate-rotund, obtuse, apiculate, broader than long, and constricted below into the very narrow sinus ; *veins* and reticulations prominent, the midrib extending right into the sub-spinose apex, margins thick, and more or less reflexed, veins eglandular, texture thick, leathery, drying (in herbaria specimens) into the grey-green colour characteristic of *G. herbaceum*, *Linn.* ; *stipules* minute, falcate, caducous. *Inflorescence* on lateral axillary shoots, 1 to 2 inches long, arrested by the production of one or more flowers and a few small leaves. *Bracteoles* 3, quite free from each other, tapering below into thick prominent claws, inserted near the base of the calyx-tube and throwing a thickening along the peduncle thus making it triquetrous, each bracteole ovate-oblong to sub-rotund, acute, on the apex deeply segmented into 9 to 11 long teeth, the central segment usually much the longest and largest ; midribs of the teeth prominent, each sending a costal vein to the next above, a little more than half the length of the corolla, accrescent, membranous, sub-glabrous, embracing and enclosing the fruit (f. 2) ; a pair of minute reddish-coloured glands are seen on the inner surface of each claw that might be spoken of as stipular developments. *Flowers* large, fully twice the length of the bracteoles, yellow, gland-dotted, with faint irregular purple spots on the claws, the older flowers having a pinkish tinge ; *petals* rotating to right, firmly united by their claws, and in consequence forming a short constricted tube, sparsely hairy on the outside ; *calyx* two-thirds length of bracteoles, almost tomentose, campanulate, loose, prominently 5-toothed, the

M. Smith delt, J. N. Fitch lith.

West, Newman imp.

No. 6. GOSSYPIUM STOCKSII, *M. MAST.*

1, Flowering branch; 2, fruiting lateral shoot; 3, a full-sized leaf; 4, clawed bracteoles with stipular glands; 5, bud showing calyx and clawed bracteoles; 6, fruit opened showing seeds; 7, seed, life size; 8, the same enlarged, showing crumpled-up floss (or fuzz); 9, seed with its floss opened out.

teeth almost awl-shaped through the thickening and prolonging of the mid-rib, veins one to each tooth and two in the sinus between, accrescent, and when ruptured by the fruit its spinose teeth look like an inner whorl of bracteoles. *Pollen-grains* having the surface of the exine packed with short opaque warts that end in short sharp spines (see Plate 53, f. 4). *Fruit* sub-rotund, suddenly apiculate, prominently dotted with black glands on a dark green-blue surface, 3-celled; *valves* rigid, but margins not reflexed on ripening (ff. 2 and 6), and seeds and wool hardly protruding; *seeds* 2 to 3 in each cell (f. 6), closely compacted together, the apex pointing downwards, triangular in section and truncate at the base, coated with a rich rusty or golden floss, which is elaborately folded or crumpled so as to look like a tomentose coating on the seed (ff. 7 and 8), but when opened out is seen to be $\frac{1}{4}$ inch long, irregular in length, hardly referable to two layers (fuzz and floss), but after removal of the red floss from the surface, the seed is seen to be smooth, black-coloured, slightly beaked (f. 9).

The lateral flowering branches, being arrested by the production of one or more flowers and a few abortive leaves, give the plant a tufted appearance that is very characteristic. After the fruits have ripened, these lateral shoots become dried up and are rarely elongated into normal leafy branches, but become false spines. This tendency is one that should prove of value in tracing out its hybrids, if any such exist.

Sind and Dhofar cotton.

Habitat.—This very interesting wild species is found near Karachi, India. Dr. Cooke says, 'It is very abundant on an extensive plain at Moach, near Karachi. It is said to bear in Sind the vernacular name of *hiraguni kápas.*' But a curious circumstance has now to be mentioned: namely, that across the Persian Gulf, on the Dhofar Mountains of South-east Arabia, Mr. J. Th. Bent, in 1895, discovered this wild cotton and thus extended the area of the species very considerably.

Citation of Specimens.—Karachi: J. E. Stocks, n. 469; Dalzell, n. 4; also an extensive series collected by Dr. Cooke; J. Th. Bent, n. 173, Dhofar Mountains.

Wild species.

Nomenclature.—There would seem little doubt that the writers who have supposed this to be the wild condition of *G. herbaceum, Linn.*, or a degenerated state of some American cotton, are alike in error. Such opinions very possibly arose through the imperfect description of *G. Stocksii* originally published. Its appearance in both Arabia and India, as a purely wild plant (were there no other considerations), necessitates its acceptance as a distinct species. But while it is as distinct from *G. herbaceum* as any two species of *Gossypium* can be, and has not been reported as having yielded by selection and cultivation any special races of cotton, still it cannot, of course, be emphatically affirmed that by spontaneous crossing with other forms it may not have contributed toward the

production of some of the races of cotton which in India, Africa, and Arabia have for many years past been referred to *G. herbaceum*.

Cultivation.—No one would, however, appear to have demonstrated by actual experiment the forms that have resulted from using *G. Stocksii* in crossing with other species, hence its influence must be accepted for the present as purely imaginary. Indeed, I am disposed to go further and question the probability of its hybridising with any cottons outside the present section. As met with to-day, it is impossible to believe that it ever could have been cultivated, since the floss is utterly worthless, and an acre, cultivated with the plant, could hardly yield more than a very few pounds of fibre (see Chapter II., p. 43).

Not cultivated systematically.

So far as I can discover, however, this is the only member of the present section of the genus that has been ever experimentally cultivated, with a view to its possible utilisation as a breeding stock. Dr. Cooke tells us that plants raised from Karachi seed 'grew luxuriantly at the Botanic Gardens, Poona, showing a strong tendency to become climbers, or at all events ramblers.'

Professor Gammie ('Cross-breeding Experiments with Cotton at the Poona Farm, 1901–03') makes no mention of his having attempted any experiments with this plant. But in his subsequent report, 'The Indian Cottons,' there occurs the following passage: '*Gossypium Stocksii*, a wild plant in Sind, is by some considered the parent stock of Indian cottons. I cannot concur in this opinion. It resembles no Indian cotton, and possesses certain characters which induce me to surmise that it is a degeneration of some American cotton. No species cultivated in Sind at the present time resembles it in any particular.' I should, however, go further and say that *G. Stocksii* bears little or no resemblance to any *cultivated* cotton, whether Asiatic, African, or American. Professor Gammie is most emphatic in deprecating belief that 'the cotton plants have become inextricably complicated and difficult to understand and distinguish through hybridisation.' A greater service could hardly be rendered, in the elucidation of the vexed question of the hybridisation of the cottons, than by the critical study of all the pure species on the part of botanists who may have the opportunity of so doing. I hold *G. Stocksii* to be such, but if I am wrong, and it is a 'degeneration of some American cotton,' let it be cultivated by every known method that tends to improvement (barring hybridisation) in order to test not only the possibility of the

Not used in hybridisation.

restoration (partial at least) of its supposed American form, but to discover how far a pure wild species can be evolved by these means alone toward an industrial state.

SECTION II.—Fuzzy-seeded Cottons with United Bracteoles.

BRACTEOLES *united below, never clawed, attached to the apex of the pedicels by a semicircular* (*or horseshoe-shaped*) *constriction within the auriculate base*; EXTRA-FLORAL GLANDS *not possessed of definite external glands, though internal ones, on the base of the calyx-tube, and alternating with the bracteoles, are usually present and conspicuous*; SEEDS *with an inner coating of velvet* (*fuzz*) *and an outer of wool* (*floss*), *firmly adherent to the seed*; PETALS *with purple claws* (cf. pp. 163–4).

Perennial or annual shrubs, with the leaves 5-palmatifid and mostly stellately tomentose, occasionally pilose with long weak hairs, or both conditions present, the pilose hairs appearing mostly on the branches, petioles, and veins, or in other forms with the leaves almost glabrescent and leathery in texture. One or perhaps two members of this section have been recorded as met with in a wild condition, the others are undoubted cultivated plants derived very possibly from four specific types—*G. arboreum*, *G. Nanking*, *G. obtusifolium*, and *G. herbaceum*. They are met with on the shores of the Mediterranean, through Africa, Egypt, Arabia, Asia Minor, Kurdistan, Persia, India, China, Japan, and the Malay Peninsula and Archipelago.

ANALYTICAL KEY TO THE SPECIES AND VARIETIES.

* *Leaves two-thirds palmately* (*sometimes almost pedately*) 3–7 *lobed*; *lobes curvilinear, bristle-tipped, and base usually distinctly cordate, central vein only with a gland.*

† Leaves glabrescent, smooth; bracteoles entire, or only slightly toothed; flowers purple
10. **G. arboreum** (type). . . . (p. 81).

†2 Leaves broader than in type; bracteoles gashed; flowers purple
11. **G. a. var. sanguinea.** . . (p. 91).

†3 Leaves hairy, coarse (bullated); bracteoles large, entire or toothed; flowers yellow, with purple claws, or with purple flush, and rarely fully opening . 12. **G. a. var. neglecta.** . . . (p. 95).

†4 Leaves softly hairy, borne on very long petioles, and lobes (often 7) radiating upwards, with base imperfectly cordate ; bracteoles relatively small, accrescent on the fruit, and then large, acute, often entire; flowers large, pale yellow or white; bolls very long
13. **G. a. var. assamica.** . . . (p. 108).

†5 Leaves rough, thick, deeply cleft into 5–7, the bottom pair thrown backwards and much shorter than the others ; bracteoles very large, but flowers relatively small, with purple claws, or white or yellow with pink tinge ; bolls relatively short
14. **G. a. var. rosea.** . . . (p. 112).

** *Leaves half-cut into* 3–5 (*mostly* 3) *lobes, the extra pair appearing as if artificially attached, thus abnormally increasing the breadth ; lobes deltoid-oblong acute or acuminate, base usually only slightly cordate ; very often all three veins bear glands below.*

† Leaves thin, smooth, compact in texture, and pilose; lobes ovate-oblong, almost obtuse; bracteoles large, purple-coloured, acute, with (usually 3) teeth on the apex ; flowers large, yellow, with faintly-coloured blotches
15. **G. Nanking** (type). . . . (p. 114).

†2 Leaves with the lobes deltoid-acuminate, and base more or less cordate ; flowers large, yellow,with purple claws 16. **G. N. var. himalayana.** . . (p. 124).

†3 Leaves small when young, densely stellately hairy ; bracteoles large, ovate, sub-entire ; flowers deep purple . . 17. **G. N. var. rubicunda.** . . (p. 126)

†4 Leaves thick, leathery, glabrescent, dots conspicuous, lobes broad sub-triangular ; bracteoles small, thick, sparsely toothed; flowers bright yellow, with purple spots on the claws
18. **G. N. var. Nadam.** . . . (p. 128).

†5 Leaves large, thin, softly pilose, lobes undulate in outline; bracteoles large, purple, entire, or with a few pointed teeth ; flowers as in nadam
19. **G. N. var. Bani.** . . . (p. 131).

†6 Leaves thick, leathery, smooth, often glabrescent, lobes ovate-acute, slightly constricted below, gland-dots very prominent; bracteoles toothed or entire, deeply cordate; flowers large, yellow, with purple claws
20. **G. N. var. Roji.** . . . (p. 134).

†7 Leaves quite glabrous, deeply segmented, and with supplementary teeth in the sinuses; bracteoles broad ovate, with margins almost deeply laciniate; flowers yellow, with purple claws
21 **G. N. var. soudanensis.** . . (p. 138).

*** *Leaves less than half-cut into* 5 (*more rarely* 3 *or* 7) *lobes, which are constricted below* (*ogee-shaped*) *obtuse or acute, distinctly cordate, central vein only bearing a gland below.*

† Leaves stellately pilose, 3- or 5-lobed, lobes obovate-oblong, obtuse, suddenly and minutely bristle-tipped; bracteoles ovate-acute, entire, or toothed on the apex only, not very profoundly cordate; flowers yellow, with purple claws
22. **G. obtusifolium** (type). . . (p. 139).

†2 Leaves ovate-rotund, often coated with persistent hairs, lobes 5–7 (rarely 3), ovate-oblong, acuminate, the sinus narrow and thrown up in folds; bracteoles relatively small, ovate-acute, deeply toothed on upper half of margin
23. **G. o. var. Wightiana.** . . (p. 143).

†3 Leaves a little more drawn out and lobes more constricted below than in †2; bracteoles subrotund, shortly and coarsely toothed around the margin . . 24. **G. o. var. africana.** . . . (p. 153)

†4 Leaves almost reniform, distinctly cordate-auriculate, leathery in texture, glabrescent on maturity, less than half-cut into 5–7 lobes, which are broad ovate-rotund, suddenly acute or acuminate; bracteoles large, broadly ovate-obtuse, profoundly cordate, only very slightly united, gashed into 7–9 fairly long teeth
25. **G. herbaceum** (type). . . (p. 155).

The Asiatic cottons.

This assemblage may be described as an essentially Asiatic and African one. As indicated in the diagnostic characters given above, all the species have the bracteoles united below by their auriculate bases: they do not possess external glands on the extremity of the peduncle, although those within the bracteoles and upon the calyx are often fairly conspicuous; and the seeds have a pronounced and conspicuous fuzz, with, in addition, a fairly liberal floss.

The expression 'the Asiatic fuzzy-seeded cottons,' when used in contradistinction to 'the American fuzzy-seeded cottons,' is useful and diagnostic. But these two descriptions must not be accepted as invariably applicable, since the former is by no means confined to Asia, no more than the latter to America. The distinction between the two sections, in the bracteoles being united in the Asiatic and free in the American, when taken in conjunction with the floral and foliar peculiarities of the assemblages concerned, would, however, seem sufficiently important and constant to merit recognition.

Arab civilisation.

I have shown (p. 16) that the modern distribution of *G. herbaceum* was closely associated with the rise of the Muhammadan power and the dispersion of that religion from Arabia through Asia Minor and Egypt to Europe on the one side, and to Persia and the frontier of India on the other. It was in all probability one of the first great annual cottons, and is closely associated with the Arabic name *Qutn*. *G. obtusifolium* originated in India as a cultivated stock, though it is possibly indigenous to Africa as well, and very probably also to the Malayan Peninsula and Islands. It has thus been closely connected with the Sanskrit name *karpasa* and the early Aryan civilisation of the Old World, and several distinct races of it may even have been carried in prehistoric times throughout Southern Asia. But there would seem enough evidence to at least suggest the belief that in India, and presumably in Africa as well, it was at first a perennial plant, and that the best annual stocks of it now met with originated within comparatively recent times.

Aryan civilisation.

Indian and African.

The influence in Southern Asia and Africa of *G. arboreum* has been co-equal with that of *G. obtusifolium*. It seems to have been indigenous to both areas, and as a cultivated plant is perhaps more closely associated with Africa and Egypt than with India. It is likely, however, that its cultivation was attempted simultaneously in both areas. It stands, moreover, a greater chance of having been found indigenous in Africa than in India, and perhaps exists there

No. 7. GOSSYPIUM ARBOREUM, *LINN.*

(A) Type of the species in Sloane Herb. B. M. (Pluk.) Vol. 96, f. 9; (B) reproduction of Pluk. Phyt. t. 188, f. 3, prepared from (A); (C) Type in Linn. Herb. Lond. named in his own handwriting as '3 *arboreum*'; (D) portion of specimen collected at Baroda by Dr. Hove in 1787, preserved in B. M.

in a more complete state of cultivation, and become more widely diversified racially, than is the case in any part of Southern Asia. While that is so, the crosses between *G. obtusifolium* and *G. arboreum* constitute by far the most abundantly cultivated forms of Asiatic cotton.

Chinese cotton.

Lastly, the great cotton of Central and Eastern Asia (a plant which extends from the shores of the Caspian to China and Japan, and is distributed southwards to certain tracts of India, Burma, Siam, and the East India Islands) may be said to be *G. Nanking*. This, after *G. obtusifolium*, is the next most important cultivated cotton in Asia. In fact the two plants have been so much inter-bred that it is often a matter of considerable difficulty to separate them—though the extreme (or pure) types are readily enough distinguished and constitute highly characteristic plants in the chief centres in which they are produced. No botanist has as yet recorded the discovery of *G. Nanking* (no more than of *G. herbaceum*) in a truly wild (indigenous) condition, but the cultivated or field 'tree cottons' of the early European explorers in Asia would seem almost invariably to have been the present species.

New World.

It was not until well into the seventeenth century that we possessed any trustworthy evidence of the Asiatic cottons having been carried to the New World. The Levant cotton (*G. herbaceum*) was the first to be taken to the United States and grown in Virginia. The Indian cottons (*G. obtusifolium*, various races) were conveyed to the States by the East India Company and the Chinese and Siamese cotton (*G. Nanking*) was carried by the French colonists to Louisiana about 1758. *G. arboreum* proper does not seem to have been successfully acclimatised anywhere in the New World, though the most important Asiatic (?hybrid) form derived from that species (*G. arboreum, var. neglecta*) was early carried to America and the West Indies by the East India Company, and is known in the United States to-day under the name of 'Okra' cotton.

10. **GOSSYPIUM ARBOREUM, *Linn.***, *Sp. Pl. 1st ed.* (1753), II., 693 (*excl. syn. Rheede*); *2nd ed.* (1763) (*excl. syn. Rumphius*) II., 959; *4th ed.* (*Willd.*), 1800, II., *Pt.* I., 804; *Prosper Alpinus, De Pl. Ægypt.* (1592) *p. et t.* 29, *also* 1640, *t.* 71, *ed. by Vesling; Plukenet, Alm. Bot.* (1696), 172, *t.* 188, *f.* 3 (**see Plate No. 7, f. B**); *XYLON ARBOREUM, Boerhaave, Index Pl. Hort. Acad. Lugd.-Batav.* (1720) I., 273; *G. ARBOREUM, Linn., Hort. Cliff.* (*in part*), 1737, 350;

G. ARBOREUM, Burm., Fl. Ind. (1768), 150 (*in part*); *G. RUBRUM, Forsk., Fl. Ægypt.-Arab.* (1775), 125; *G. ARBOREUM, Lamk., Encycl.* II., 134; *Cav., Diss.* (1785–90), 311, *t.* 165; *Poir., Dict. des Scien. Nat.* (1818), XI., 38–9 (*excl. syn. Rheede*); *DC., Prod.* (1824) I., 456 (*excl. syn. Rheede*); *Roxb., Fl. Ind.* III. (1832), 183; *Wall., Cat. No.* 1881*a*; *Parlatore, Sp. dei Cotoni* (1866), 23–29 (*excl. syn. and plate*); *Royle, Ill. Him. Bot.*, 99, *t.* 23, *f.* 2, *& Cult. Cotton. in Ind.*, 144 (*in part*); *Wight, Icon. Pl. Ind. Or.* I., *t.* 10 (*in part*); *Maxwell Masters, in Oliver, Fl. Trop. Afr.* I., 211, *also in Fl. Br. Ind.* I., 347 (*in part*); *Todaro, Relaz. Cult. dei Cotoni* (1877), 176–180, *t.* 1*a*; *Aliotta, Riv. Crit. Gen. Goss.*, 1903, 56–65 (*in part*); *Gammie, The Indian Cottons*, 1905, 4–5; *Dict. Econ. Prod.* IV., 5–14.

Tree Cotton of India and Africa: *Deo-kapás, Nurma, Manua, Bajwara, Red Navsari, Ram-kapas*, &c.

Description.

When dealing with the typical condition of the species it may be spoken of as a small tree or large shrub, with very slender, terete, often purple-coloured, and almost quite glabrous branches, but with the younger parts sometimes more or less woolly. Leaves in texture firm, smooth, distinctly cordate, two-thirds palmately 5–7-lobed, lobes oblong lanceolate, with often a supplementary lobe (or tooth) within the lateral sinuses, margins reflexed, tips with minute bristles, central vein only with a gland below (**Plate No. 8, f. 1**). Inflorescence short abortive shoots; bracteoles comparatively small, united below, ovate cordate, acute, entire or occasionally toothed, purple-green. Flowers large, deep shining purple, with darker patches on the claws and petals rotating to left. Seeds large, irregular in form (**f. 4**), coarsely coated with greenish-grey velvet (fuzz) below the firmly adhering white silky floss; in the wild states red coloured. (**See Plates Nos. 7 and 8.**)

A perennial, usually from 6 to 10 feet in height, having long trailing thin branches. *Stems*, and more especially the young branches, petioles, peduncles, and bracteoles, of a deep glossy purple colour, a peculiarity sometimes even possessed by the young leaves, especially on the under surface. *Leaves* of a thick and leathery consistence, gland-dotted, subglabrous (when dry sometimes appearing as if quite glabrous), or having short, abortively stellate hairs on the blade, more especially the under surface, and a few longer spreading hairs on the petioles and young shoots (a greater degree of hairiness may be observed in association with other departures, indicative of varietal, racial, or hybridisation forms); blade of the leaf mostly 5-lobed (and in a manner which, when compared with the

M. Smith delt. J. N. Fitch lith. West, Newman imp.

No. 8. GOSSYPIUM ARBOREUM, *LINN.*

1, Flowering branch; 2, bud showing calyx with its glands and gland dots; 3, young fruit acuminate and beaked; 4. fuzzy seed; 5, seed with floss removed.

cottons as a whole, might be described as almost pedately lobed, with occasionally an extra tooth on one or on both sides of the central lobe); lobes curvilinear in outline, that is, only slightly constricted into the more or less open sinus; midribs distinct, the central one very frequently purple-coloured; *petioles* about the same length as the longest lobe, thin, straight; *stipules* falcate (narrow, acuminate, membranous), caducous, those on the lateral flowering-buds with one broader than the other and sometimes slightly toothed. *Inflorescence* much elongated, shoots with many lateral axillary buds, which mostly become abortive so as to yield but one, or at most two flowers (**Plate 8, f. 1**), which thus appear as if borne on jointed peduncles, with one or two diminutive 3-lobed leaves at the joint; the jointed *peduncle* is usually shorter than the subtended petiole, and the portion above the joint is generally trigonous and shorter than the lower portion; *bracteoles* small (usually one-third the length of the corolla), veins few, circular attachment often conspicuous but not glandular, glands within the bracteoles and on the calyx large and purple (**ff. 2 and 3**). *Calyx* truncate, or only slightly 5-angled, gland-dots very distinct (**f. 2**). *Corolla* not quite three times the length of the bracteoles, constricted below, convolute and convolvulate, deep purple-red, with darker patches at the base and well-marked hairy folds. (Some of the hybrid states have the corolla scarcely distinguishable from the yellow with purple blotches of *G. obtusifolium* or of *G. Nanking*). *Capsule* more or less rounded, 3- (rarely 4-) celled, acuminate (**f. 3**), very rarely flattened, 6–8 seeds in each cell, valves with the margins reflexed. (Cf. pollen grains, p. 345, and **Plate No. 52, ff. 7 and 10.**)

Africa, Arabia, India.

Habitat.—It has often been claimed that this is originally an African species, but it is doubtful whether any botanist has ever discovered it in what could be regarded as an undoubted indigenous habitat in any country. So far as botanical publications are concerned, it was figured and described by Alpinus as an Egyptian plant a hundred years before Plukenet wrote of it, '*Gossypium herbaceum Maderaspatense.*' It is said to be met with in gardens (especially near temples) in Egypt, Africa, Arabia, India, and, though much less abundant, is also found in China, Japan, Java, and the Malaya. Safford (*l.c.*) appears to be alluding to this species in his 'Useful Plants of the Island of Guam,' where he says it is introduced and planted near houses. Lamarck (quoting Sonnerat, 'Hist. Voy.' x., p. 460), speaks of it as growing plentifully in the plains of Macassar, but Poiret (who compiles from Lamarck) drops all mention of the Macassar cultivation, and says it is considered the finest cotton in India and is sought for on account of its pliancy and whiteness.

Citation of Specimens.—In Linnean Soc. Herb. London—Linn. Sp. n. 3 (see **Plate No. 7 C**). In the Kew Herbarium the INDIAN examples of this plant are by no means either numerous or very characteristic. The best specimens are:—Wight, n. 176 (named *G. album, Ham.*); Edgeworth,

n. 231, fron North-west India; Rottler, specimen (in which the calyx is almost 5-toothed, the plant approximating to *var. sanguinea*); Wallich, n. 1881, typical, ex herb. Heyne; Wight, n. 214 (named *G. herbaceum* a hybrid state of this plant, with the segments of the leaves broader than is usually the case and the capsules larger and more linear in form, thus approximating to *G. Nanking*). Lastly, in the Kew Herbarium there is a sample from the Malay, viz. Horsfield, 'Javan *Kapas*,' n. 1192 (that may be spoken of as a fairly good example of this plant, though, perhaps, a trifle too hairy, thus approaching to *var. sanguinea*).

In the British Museum—Sloane Herb. (Pluk.), vol. 90, f. 38, a red-flowered cotton, locality (?) India; vol. 93, f. 185, said to be t. 188, f. 3, collected (?) by Dubois, locality (?) India; vol. 96, f. 59 (type) (**see Plate No. 7 A**), locality not stated; vol. 100, f. 107 (locality not stated); (Petiver), vol. 165, f. 212 (collected by Camel, var. (?); Boerhaave), vol. 322; Forskal's own sample of *G. rubrum* and named *hadie*; Dr. Hove's sample of perennial cotton collected at Baroda (**see Plate No. 7 D**).

In the Edinburgh Herbarium there are many good specimens of this species from India, such as Wight, n. 179 (ex herb. Greville, named *G. nigrum*, *Ham.*, and a duplicate, n. 176, named *G. album*, *Ham.*), also a specimen from Dr. Cleghorn, collected in the North Panjab.

In the Cambridge University Herbarium, in addition to duplicates of some of above, Dr. Kelaart's specimen from Ceylon may be specially mentioned, and Schimper's Abyssinian plant, n. 691, which may be a hybrid of *G. arboreum* × *G. Nanking* (see *Roji*).

In De Candolle's Herbarium, Geneva, there is a sample by Zollinger from Java, collected in 1853, as also a duplicate of Wight's n. 176.

In the Herbaria of Florence and Naples there are very few typical examples of this species. The specimens so named in Parlatore's handwriting are, however, mostly *G. neglectum*, *Tod.*

In the herbarium of R. E. P., Calcutta, n. 1761 was collected by myself in a field near Palitana, Kathiawar (cf. with *var. sanguinea*).

Nomenclature.—Since Linnæus, in defining this species, republished the description given by Plukenet, and since the actual plant from which Plukenet's plate ('Alm. Phyt.,' t. 188, f. 3) was made is still preserved in the Sloane Herbarium of the British Museum (**see Plate No. 7, ff. A and B**), that description and plate must be accepted as manifesting the type of the species botanically. But in the Linnean Herb. there is, in addition, a good specimen, which is named '3 *arboreum*' in Linnæus' own handwriting (**see Plate No. 7 C**), and this exactly matches Plukenet's plant. There is no difficulty, therefore, as to the botany of this species, if some of the synonyms that subsequently came to be quoted under it be excluded. But there is, however, a practical fact of some value that may be here recorded. In Plukenet's herb. (now a portion of the Sloane Herbarium) have been preserved several specimens, and one of these bears a ripe fruit. The cotton from that plant has

Early specimens.

been examined by me, and appears superior to the average quality obtained nowadays from *G. arboreum*. Buchanan-Hamilton, who gave special attention to the subject of the Indian cottons, did not, seemingly, preserve a specimen of the typical arboreous form of this species in his herbarium. Sets of his plants are to be seen in the Kew, the British Museum, the Wallichian and in the Edinburgh Herbaria, more especially the last, and among these may be discovered admirable samples of a red-flowered herbaceous plant, which, botanically, is derived almost immediately from *G. arboreum*, with possibly a strain of *G. Nanking*. Of that plant Buchanan-Hamilton has recorded the following observation :— '*n.* 1549, *G. nigrum, vide comment. meum in Hort. Mal. p. primam. var.* (*a*) *rubicundum: G. indicum, Willd. Sp. Pl. III.*, 803 (?) *Colitur ubique in India vulgatissima.*' Now if the plant shown by that specimen (**see Plate No. 9**) was cultivated everywhere in India, and very common in 1809, it must be spoken of as absolutely unknown to-day and its place taken by a multitude of forms, of yellow-flowered plants, considerably more remote from *G. arboreum, Linn.*, type than that just mentioned.

Hamilton's Field crop.

So far as presently known the arboreous form (which may be called the typical condition) can hardly be said to be cultivated as a source of fibre to-day, though, according to Indian tradition, it is the cotton that should be selected in preparing the Brahmanical string, as also for the wicks of lamps to be burned in temples, and it has been often affirmed that this was the cotton specially used by the Egyptian priests (Gerarde, 'Hort.' 1597, p. 753) in the construction of their robes. It would seem, however, that some hesitation should be manifested in accepting the frequently-asserted antiquity of the Egyptian knowledge in cotton. Pliny speaks of Ethiopia, bordering on Egypt, as possessing wool-bearing trees. That Ethiopia and Arabia have had perennial tree cottons from the most ancient times (possibly forms of *G. arboreum*) there would seem to be no doubt, and Forskal's specimen of *G. rubrum*, preserved in the British Museum, is certainly *G. arboreum*.

Brahmanical string.

Serapion, who lived about 850 A. D., quotes still earlier authors. One of these, Abu Hanifa, says that at Kelbe cotton grows on trees, which are like those of the quince, and last for twenty years, though they are in their best condition during the ninth year. Ebn Baithar also furnishes an interesting account of the cotton-plant, and praises garments woven of its fleece. (Cf. with the

Arab authors.

remarks under *G. Nanking var. Roji.*, p. 135.) But in Lower Egypt the cultivation of a cotton-plant does not very possibly date further back than the thirteenth century.

Egypt.

Abdollatiph—an Arab physician who visited Egypt in 1200 A.D. and published a list of the useful plants seen by him—makes no mention of cotton. Prosper Alpinus (who visited Egypt in 1580 and published his 'De Pl. Ægypt.' in 1592) says of the plant figured and described by him, that it was only grown in a few gardens, and that the Egyptians import the cotton they use, since the herbaceous plant of Syria does not grow in Egypt. Belon ('Plurim. Singu. Rer. in Græcia Observ.' 1589, p. 295), who visited Egypt about the same time as Alpinus, makes no mention of cotton in that country though he speaks of cotton trees as seen by him on the hills of Arabia near Mount Sinai. He also observes that the garments woven of it are finer than silk and whiter than those of cotton, by which he presumably means Syrian cotton.

The Egyptian frescoes and sculptures frequently represent fields of corn or of flax, but never of cotton—a circumstance that it would be difficult to account for had cotton been regularly grown and its extremely valuable fibre understood by the early Egyptians. Yates ('Text. Antiq.' pp. 334–53, 453 and 467–72) says that copies of Pliny and also of Julius Pollux (a century later) had marginal notes inscribed on them, regarding cotton cultivation in Egypt during the fourteenth century. Subsequent editions of these classics erroneously incorporated these notes into the original text, and hence had come about the belief that cotton cultivation in Egypt had been described by Pliny and Pollux, whereas there is no evidence of Egyptian knowledge of the cotton plant prior to the thirteenth century. Many of the Arab writers, however, speak of what appears to be the fibre or this species, as spun and woven, and of the textiles thus produced being called *sessa*, so that there seems little doubt its utilisation, if not cultivation, dates from fairly ancient times in Arabia, and was continued to at least the middle of the sixteenth century.

Pliny: Pollux.

In a further page I shall endeavour to deal with the cultivated forms of *G. arboreum*, *Linn.*, and to cite well-known specimens in herbaria. It is desired here to establish the belief that there can be accepted as existing a special form which, if not an original wild stock and, therefore, botanically a species, is remarkably near to what we are justified in believing may have been one of the ancestral stocks of many of the cultivated cotton plants of the Old World.

Original wild stock.

And it need only be added that the classic records of a 'tree-cotton' carry us many centuries beyond the first mention of a herbaceous field crop; and what is more curious still, most of the early writers on Indian cottons such as Rheede, Terry, Rumphius &c., describe and figure 'tree-cottons' (from admitted personal knowledge), but say absolutely nothing about the improved herbaceous field cottons.

Thus, while little is known for certain of the origin of *Gossypium arboreum* there seems no doubt whatever that it played an important *rôle* in the production of some of the best known cultivated cottons of the Old World. It is accordingly desirable (as already explained) to assume the existence of a wild species, such as that briefly indicated by the older authors. And in part support of that view it may be added that, when neglected, the cultivated forms become perennials and rapidly assume the leading characteristics of the plant briefly defined above, irrespective, apparently, of environment.

Cultivation.

Varieties and Races.—From what has been said already it may have been inferred that I regard *G. arboreum. Linn.*, as embracing several fairly distinct forms, some of which at least have been assigned independent specific positions by certain authors. This fact naturally extends the habitat of the species and enlarges its specific characteristics, but any ambiguity that might thereby be occasioned is at once removed when the synonymy and area of distribution of each is reviewed separately. *G. arboreum* proper has, therefore, to be accepted as the typical condition of an extensive assemblage of forms, races or hybrids, which all originated in the Old World. The typical condition seems more prevalent in India than elsewhere; *G. sanguineum, Hassk.* is possibly of African origin. Indeed one or other of the forms of this truly protean plant occurs here and there from Africa and Egypt, east and south throughout the whole of Asia.

Specific limitations.

Racial Tendencies.—It will be seen, from the qualifications that have now to be made, in order to embrace the very numerous series of cultivated plants referable to this species, that while a natural assemblage of characteristics is preserved, hardly any one feature is constant. Thus for example the flowers may be yellow, the leaves may be very considerably hairy, and the velvet of the seeds may be grey or brown: that is to say, the seeds have lost their green colour, which is perhaps their more typical condition. The arboreous form

Colour of flowers.

occurs chiefly (so far as India is concerned) when it appears as an ornamental garden plant, and its bushy condition whenever it is grown as a field crop. The transition from the structural peculiarities of the arboreous to those of the bushy states is, however, so gradual and continuous that it is often possible (with a fairly extensive collection) to arrange a panorama, which on the one side would pass through numerous hairy conditions to *G. neglectum*, *Tod.*, and ultimately to *G. obtusifolium*, *Roxb.*, and on the other an assortment of less hairy forms with a more leathery texture of foliage would pass almost imperceptibly to *G. Nanking*, *Meyen*, and finally into *G. herbaceum*, *Linn.*

Arboreous and bushy forms.

Hairy and glabrous forms.

Climatic Assortment.—The former assemblage loves a moist tropical clime, while the latter frequents dry and often cold regions. The hairy forms are almost characteristic of the plains and central tableland of India or of tropical Africa; while the sub-glabrous states, though met with on the mountains of the extreme south and again on the north of India, are diffused through Central Asia to the Mediterranean area and to the more northern portions of the cotton regions of China and Japan.

Within the panorama mentioned every form of Asiatic cotton might find its place, and thus frustrate the attempt to isolate them into varieties, still more so species. Experimental cultivation has shown fairly conclusively that this state of affairs has been brought about to a very large extent by hybridisation, or perhaps it should rather be called crossing. The tendencies of 'reversion' are towards certain fixed characters, and these, in the writer's opinion, justify the retention of certain forms as species or varieties. For example, the leaves of *G. arboreum* are comparatively sub-glabrous, are of a leathery texture, and in the herbarium dry into a soft pale green or greenish-yellow colour. They are 5–7 (mostly 5–, very rarely 3–) segmented, the lobes being curvilinear in form and rarely one quarter the breadth of their length. The bracteoles are of a thick texture and hairy, ovate, oblong, acute, with generally only 3–4 teeth on the upper extremity, or they are quite entire. The flowers are of a rich rose-purple colour.

Hybridisation

Hybridisation.—When grown as a field crop, *G. arboreum* may be either an annual or a perennial, and in the latter case is generally sown in rows, being thus employed as a catch crop or to shade more delicate annual cottons or other plants. But these agricultural forms are so much modified, very possibly by hybridisation, that

they cannot be regarded as constituting varieties—in fact many of them are but climatic sports that lose their properties on being translated from one region to another. Hence the flowers may either be purple with darker blotches, or yellow with purple blotches in the throat, or even pale yellow with only a pinkish tinge on the outside. Climatic sports.

The purple colour is the type condition of the species, the other shades being the results, doubtless, of special cultivation or hybridisation. It would not be difficult in fact to mention several undoubted hybrids produced artificially, but one may suffice for the present purpose. Mr. Alexander Burns, then of Broach, reported to the Chamber of Commerce of Bombay in 1844 that he had taken the pollen of what he calls *G. herbaceum* and artificially fertilised with that the stigma of a *G. arboreum* flower. The result was that he produced a vastly improved hybrid staple. He accompanied his report with three coloured illustrations (which are before me now). One is *G. arboreum, Linn.*, undoubted; the other looks more like *G. Nanking* (*Roji*) than *G. obtusifolium, var. Wightiana* (Surat cotton as he calls it), the plant used as the male ancestor. The third picture is a perfectly intermediate condition—a mosaic hybrid in the first generation—in which the leaves have the lobes much broader and longer than in *G. arboreum*, but more deeply palmatifid than is customary with *G. obtusifolium*; while the flower has a purple centre with a ring of yellow around and a purple border to the tips of the petals. The colour of the stem is described as green, not purple, as in *G. arboreum*, and the whole plant is at the same time very hairy. See p. 335. Purple colour. The Broach hybrid. Mosaic hybrid.

The crossed seed was sown alongside of both its ancestors. *G. arboreum* flowered from November to April—the usual flowering of that species; the hybrid blossomed and yielded its crop within the space of two months, as is customary with the Surat cottons. The new stock, moreover, yielded a larger quantity than is the case with *G. arboreum*. The produce of 50 bolls was examined and compared with a similar number of characteristic bolls of *G. arboreum*. The result was 28 per cent. wool and 71 per cent. seed in the hybrid, and 22¼ per cent. wool and 77 per cent. seed in the ordinary arboreous plant, the balance in both cases being dust. The quality of the wool was also greatly improved. In addition to these accurate details of a hybrid actually produced, there is a further point of interest. Mr. Burns speaks of *G. arboreum* as if it had been a regular field crop in Gujarat even so late as 1844. Seasons. Yield.

Hybrid stocks.

There is thus no manner of doubt as to the possibility of hybrids, nay, more, as to the existence of many hybrid stocks in every cotton-growing country in the world. Reverting to India, it can be said that with a little practice the recognition of such forms becomes, moreover, almost intuitive, so that one feels justified in arranging forms which manifest varying degrees of participation in the *G. arboreum* influence. The value of such intuition becomes apparent when it is seen that the classification thus established bears a fairly definite relation to recognised qualities or agricultural crops of ascertained property, such as suitability to particular climates and soils, or to the capabilities of the cultivator. And there is still another signification of no small importance, viz. historic evidence.

Ancient cultivation.

It may be accepted, moreover, that in India at least *G. arboreum* cultivation is quite as ancient, if not more ancient than that of any other cotton. In recognising, therefore, a strain from that species we have determined a feature of great strength, one might almost call it of prepotency, some aspects of which it may be the object of cultivation to develop or to eradicate. For example, several of the Indian races or hybrids of cotton, referable to this species (primarily),

Soft silky floss.

may be regarded as having derived from *G. arboreum* the soft silky character of their flosses, while the length and strength of their staples have come to them from the other ancestral elements. In others a strain from *G. arboreum* would seem to have been sought on account of the strength thus imparted to withstand seasonal climatic changes, the plant for the most part becoming a hardy perennial. And some of these arboreous races or hybrids are accordingly met

Inferior soils.

with on the most inferior soils that are ever placed under cotton.

Moreover, it would seem probable that the Indian cottons, the loss of which merchants often deplore, had fairly long staples and were possessed of a silkiness which in all probability had been derived from *G. arboreum* or *G. Nanking*.

There are many cultivated states of the present species found all over India, Egypt, and Africa. As already explained, these manifest a constant tendency to throw back towards the arborescent plant with

Annual races.

dark purple flowers, whenever they are allowed to become perennial or to be naturalised. The annual races may be regarded as chiefly hybrids of *G. arboreum, Linn.*, with *G. obtusifolium, Roxb.*, and possibly also *G. Nanking, Meyen*, the most prevalent of these crosses being *G. neglectum, Tod.* (= *G. viridescens, Ham.*).

Seminal selection.

Selection from seminal sports may also, of course, have given origin to not a few of the *G. arboreum* races, but the writer believes

that, with the present species, this may have been a far less potent agency than is generally supposed.

Climatic influences.

At the same time it is quite true that many of the races of *G. arboreum* are immediately influenced or modified by altered conditions of climate, soil, and methods of cultivation. This, of course, is true of all cottons, but more especially so of the particular group of forms here dealt with, where the prepotency of *G. arboreum* seems so very strong. The range of variation within the series is remarkable. Without affirming whether these are varieties, races, or hybrids, the writer would mention, as indicative of the assemblage, the plants that have come to bear the names of *G. sanguineum*, *Hassk.*, and *G. neglectum*, *Tod.*; but there are others, many of which have not received botanical names, though none the less referable to the series and equally worthy of notice.

Nurma.

The more typical and representative members have in India, from time immemorial, been known by the collective vernacular name of *Nurma*. They are, as a rule, small ornamental trees or large shrubs grown in gardens. The fine red-flowered field cotton, so much extolled by early writers, may have been *G. rubicundum*, *Roxb.* (a plant presently to be described). But it may in passing be here mentioned that a specimen of it is number two in the Linnean herbarium and bears in Linnæus' own handwriting the name *præstantissimum*. **(See Plate No. 17 A.)** He has nowhere defined that species, and the suspicion of an error suggests the question, could he have confused this with Tournefort's *Xylon Americanum præstantissimum semine virescente* which Philip Miller and after him Linnæus himself accepted, for a time at least, as part of the description of the plant now known as *G. hirsutum*? **(See Plate No. 29 A.)** If that suspicion be correct, it once more shows how hopelessly the 'Species Plantarum' is at variance with the plants actually known to the great author himself. The following are some of the more remarkable varieties or cultivated races of *G. arboreum*:

Red-flowered field plant.

11. Var. sanguinea, *Watt:* *G. SANGUINEUM*, *Hassk.*, *Cat. Hort. Bog. p.* 200; *G. PUNICEUM*, *Jacq.*, *Eclogæ Pl. Rar.* 1844, II., *p.* 7. *t.* 134 (*is a red-flowered cotton, country unknown*); *Todaro, Relaz. Cult. dei Cot.* 1877–78, 179, *t.* 1.

Red-flowered field crop.

A red-flowered field cotton.

This form is apparently only rarely met with in India. There are in India, however, several distinct races of red-flowered field

cottons, and apparently in many other countries as well. These may be grouped into two sets: (*a*) those which belong to *G. arboreum* and (*b*) those that more appropriately should be assigned a position under *G. Nanking*. Perhaps the best representative of the former is *var. sanguinea*, and of the second *var. rubicunda*. The Indian manifestations of what may be called *var. sanguinea* approximate, however, almost more closely to the typical *G. arboreum* than to the special African form described by Hasskarl. It may serve the purpose of the present work, therefore, to deal with both the Indian and African forms collectively, the more so since they are but varieties, perhaps only cultivated races (certainly not species), and blend almost imperceptibly from the one to the other. (See Plate No. 9.)

Description.

The special variety *sanguinea* is distinguished from *G. arboreum* proper by the following:—Stems, twigs, and petioles finer, and also the blade of leaf thinner in texture, more hairy and more distinctly purple than that already described. *Leaves* also larger, lobes usually broader and sometimes scarcely constricted. *Bracteoles* very much larger, more deeply and acutely gashed. *Flowers* purple, with darker throats. *Calyx* very often distinctly five-toothed. *Capsule* almost linear and much acuminate. *Seeds* with grey or only slightly greenish velvet; floss longer and superior in quality to that of *G. arboreum* proper.

Habitat.—Africa.

Akese cotton.

Citation of Specimens.—Africa: Upper Guinea.—Dr. Irving, n. 3, Abbeokuta (*Akese* Cotton—collected in Feb. 1855, in flower), in this the bracteoles are large (at least half the length of the corolla), pronouncedly toothed, the leaves a little more hairy and the lobes narrower than in the corresponding Indian examples, so also the capsule is oblong, acuminate, and the glands at the base of the calyx are covered with longish hairs. The same plant was collected by Dr. W. B. Baikie in West Tropical Africa (Niger), and also by Barter (n. 1182) in the Niger Valley. Of this sample Dr. Barter very properly remarks that the staple is long and good.

The African plants would thus seem to manifest a further development, possibly a strain of hybridisation, and in consequence are superior to the Indian arboreous stocks, as staple yielders. A specimen collected by Dr. W. Rowland, near Lagos (West Tropical Africa), has the leaves and bracts very large and the calyx five-toothed. There does not appear to be any Abyssinian specimens of *G. arboreum* in the Kew Herbarium. Arabia: Hedjchas Prov.—Dr. W. Schimper, n. 1025—a form of *G. arboreum* which, like some of the African and Indian examples, shows an approximation to *G. neglectum, Tod.*

Turning now to the Indian series, many of which might be more correctly described as red-flowered races of *var. neglecta* than of *sanguinea*, the most remarkable specimens seen by me are Dr. Buchanan-Hamilton's, n. 1549, preserved in the Edinburgh Herbarium (see Plate No. 9), to which reference has been made above. Professor Middleton collected a good specimen in a garden at Baroda, where it was given the name of *Nurma*.

No. 9. GOSSYPIUM ARBOREUM, *LINN.*

Herbaceous cultivated race.

(A) Specimen in Edinburgh Herbarium collected by Dr. Buchanan-Hamilton at Gongachora, in Eastern Bengal, in 1809—half life size; (B) leaf from the same, full size; (C) Hamilton's original label; (D) additional information in MS. Catalogue.

In that particular sample the bracteoles are small, like those of typical *G. arboreum*, and the seeds have a green fuzz. I have also seen good specimens from Madras, where the plant appears to be occasionally grown under the name *Semparuthi*. I collected in 1890 a red-flowered field cotton at Lahore which comes fairly near to *var. sanguinea*. In a field at Palitana, Kathiawar, I also found a plant (n. 1761) that in my notes I described as a purple-flowered example of *var. neglecta*. Two specimens of red-flowered cottons have been sent to me from the Poona and Kirkee Experimental Farms (ex Herb. R.E.P.), viz. n. 21,881 red-flowered Navsari and n. 21,882 named Dev-kapas. Both these are aberrant forms of *G. arboreum* with the leaves on the pattern of *var. neglecta*, only less hairy and the bracteoles more deeply toothed than is customary with that plant. In the British Museum Herbarium there is a specimen from Bangkok, Siam, a hybrid approaching *sanguinea* × *Nanking*; also Zimmermann, n. 131; and Java, Horsfield (*ex* Shuttleworth's herb.). In the Cambridge Herbarium (Lindley's set) there is a specimen collected in Coimbatore by Wight.

Semparuthi cotton.

Nomenclature.—A red-flowered field cotton is incidentally mentioned by many of the older botanical writers and also the early travellers. Some of these have already been mentioned under *G. arboreum*. Lamarck, for example (quoting from Sonnerat, 'Hist. Voy.' x. p. 460), speaks of a red-flowered cotton growing plentifully in the plains of Macassar. This has already been mentioned, and is only repeated here as the plant in question was in all probability *var. sanguinea*.

Macassar cotton.

Dr. Buchanan-Hamilton collected cotton specimens in Bengal, during the opening decade of the nineteenth century. His specimens are in an admirable condition, and thus afford by far the most satisfactory conception of the cotton plants of the eastern side of India a century ago. Mention has just been made of his sample n. 1549, but it may be useful to afford a few additional particulars gleaned from the original records preserved in the Edinburgh Herbarium. The specimen has been photographically reproduced in **Plate No. 9,** one leaf (**B**) natural size, the remainder (**A**) half size. Hamilton's original label (in his own handwriting, **C**) shows the name he gave it (*G. nigrum, rubicundum*), and below has been added a further label (**D**) recording the particulars given in Hamilton's MS. Catalogue. It is distinctly a red-flowered example of a field plant. It was collected at Gongachora on June 30, 1809, and was then in flower. In his catalogue he records his determination of it as *G. indicum, Willd. Sp. Pl.* III., 803; *G. javanicum, Herb. Amb.* IV., 34; *and Pluk. Alm.*, 172, *Phyt. t.* 188, *f.* 3. But his remark, '*Colitur ubique in India vulgatissima*,' is most interesting. He gives it the Bengali name of *banga*, and says it is known to the Burmans as

Bengal cottons.

Red-flowered field cotton.

Wa-been. Now if the plant shown by that specimen was cultivated everywhere in India and very common in 1809, it must, I fear, be spoken of as possibly quite unknown to-day. Its place has been taken by a multitude of forms with yellow flowers and considerably lower staples, that are even more remote from *G. arboreum* than the plant here discussed. This observation is rendered significant through the further circumstance, namely, that there are in Hamilton's herbarium two samples of a yellow-flowered plant. These he called collectively by a name never actually published, viz. *G. viridescens* (*cf. Wall. Cat.*, 1880*b.*, *ex Herb. Ham.*). Hamilton, in fact, seems to have thought there were two forms of his *viridescens*, and these he named as follows : 'n. 1553 *herbaceum*' and 'n. 1552 *hirsutum*.' These will be presently more fully discussed but they seem very nearly identical one with the other, and, moreover, are indistinguishable from *G. neglectum, Tod.* In passing, therefore, it may be added that Hamilton's *viridescens* hopelessly confused (as was customary at that time) two quite distinct species, viz. *G. herbaceum* and *G. hirsutum.* But the chief interest in these two specimens is the remarks regarding them : 1553 he speaks of as '*Colitur in Mithila agris*,' and of 1552 '*Colitur in Mithila arvis*.' Obviously, therefore, they were much less frequently grown in Hamilton's time than his red-flowered plant, and infinitely less than at the present day.

Yellow-flowered forms.

Passing to the other side of India, a still earlier explorer, Dr. Hove, studied the cottons of Guzerat (in 1787), and his specimens are preserved in the British Museum. Among these is a sample hardly distinguishable from Hamilton's Bengal plant. Hove wrote of Cambay, on November 6, that the cottons were then 'in full bloom, with scarlet flowers, and quite another species from the yellow-flowered bush grown at Diroll, in Broach.' 'On my journey,' he continues, 'to Kerwan, in Cambay, for the space of sixteen miles, wherever I cast my eye I could see nothing else but cotton plantations. Where the soil consisted of a heavy clay, those districts were planted with the yellow sort, and those which consisted of sand, or were situated higher from the adjacent ground, were planted with the red species.' He then goes on to say, 'that in the second year the red-flowered bushes grow to a height of seven feet, but in order to make them bushy and to cause them to yield a large crop, they have to be twice pruned—once when they are only three feet high; the shoots are then cut down by a foot, and the second pruning takes place after the first crop has been collected.' (Pruning

Bombay cottons.

Pruned cottons

No. 10. GOSSYPIUM ARBOREUM, *LINN.*, VAR. NEGLECTA, *WATT.*

(A) Roxburghian specimen in Kew, named '*G. hirsutum*' ex herb. Forsyth; (B) ditto, named '*G. herbaceum*'; (C) specimen in B. M. supposed to have been furnished by Roxburgh and named by him '*G. hirsutum.*' On the reverse of the sheet is '*India Orientalis*—Dr. Roxburgh (ex. America introduced).'

perennial cottons, to make them yield better, it will be found is mentioned by many writers.)

At Desberah, in Broach, Hove was told the red cotton was known as '*Dyva Nerma Capass.*' As seen at Sabermatty, it had blossoms of a prodigiously large size, not unlike 'the *Gossypium arboreum* on the coast of Guinea.' At Sunerwara the red-flowered species was called *Semul.* One of the most remarkable features of Hove's account of the Bombay cotton cultivation, 120 years ago, is the stress he lays upon the necessity for free irrigation, with yellow-flowered cotton, which in this respect differs, he adds, materially from the red.

Red-flowered cottons.

From Hamilton and Hove we are thus driven to the belief that a red-flowered cotton was, a century ago, both more abundant and more important than it is to-day. Still, however, here and there special mention is made of red-flowered cottons existing as regular crops even to-day. Messrs. Duthie and Fuller ('Field and Garden Crops of the United Provinces of India,' I., 75), after dealing with the prevalent form of cotton (*var. neglecta*), observe that in Oudh and the more eastern districts of the provinces, there 'is a species known as *G. arboreum*, with much fleshier and more shining leaves.' It is ordinarily known as *narma* or *mannu*, and a superior variety, met with in Allahabad district, is called *radya.* Both these differ greatly from the ordinary cotton (*kapas*) in the season of their growth, not bearing cotton till the hot-weather months instead of the end of the rains. It will be recollected that Hamilton's specimen (n. 1549) was in flower in June, and would thus seem to have corresponded with the Oudh plant. I have not, however, seen authentic specimens of these Oudh cottons, but have little doubt in accepting them as being either forms of *G. arboreum, var. sanguinea* or of *G. Nanking, var. rubicunda.*

The subject of the red-flowered field cottons of India (of the *G. arboreum* series) would thus seem well worthy of fresh and exhaustive study. (Cf. with the remarks below under *G. Nanking, var. rubicunda*, p. 127.)

Bengal cotton.

12. Var. neglecta, *Watt:* *G. NEGLECTUM, Tod., Relaz. Cotoni, Palermo* (1877), 169–75; *CUDU PARITI (ALCEA MALABARENSIS), Rheede, Hort. Mal.* (1686), I., 55, *t.* 31; *G. HERBACEUM MADERASPATENSE MINUS, FLORE SULPHUREO PENTAPHYLLÆUM PARETTY MALABARORUM, Plukenet, Amalth. Bot.* IV., 107;

G. HERBACEUM, Burm., Fl. Ind. (1768), 150 (*in part*); *G. ARBOREUM, Miller, Gard. Dict., 8th ed.* (1768), *n.* 3—*Tree Cotton, with a yellow flower*; *G. HIRSUTUM, Hill, Veget. Syst.* (1769), xv., 19, *f.* 4; *TRANQUEBAR COTTON, Rohr, Observ. sur la Cult. du Cot.* (1807), 62-64; *G. HERBACEUM, Roxb., Fl. Ind.* III., 184, *and Pl. Coast Corom.* (1819), III., 66, *t.* 269, *also Bengal and Dacca Cotton MSS., drawings* (*here reproduced*, **Plates Nos. 11 and 12**); *G. VIRIDESCENS, Buch.-Ham., MS., both varieties* (*n.* 1553 *herbaceum and n.* 1552 *hirsutum*); *Royle, Ill. Him. Bot., t.* 23, *f.* 1; *G. OLIGOSPERMUM, Macf., Fl. Jam.* (1837), I., 74; *G. PUBESCENS, Splitg., MSS. Vriese in Nederl. Kruidk Arch.* I. (1848), 334; *G. INDICUM, Royle, Cotton in India* (1851), 142, *t.* II., *also* 148, *t.* III., *f.* 1; *G. ARBOREUM, Parl., Le Sp. dei Cotoni*, 1866 (*in part*), 25-9, *t.* I. (*excellent picture of this variety*): *G. ROXBURGHII* (p. 45) *et G. INTERMEDIUM, Tod.* (p. 41), *in Osser, su Tal. Sp. di Cot.*; *Müll., Walp. Ann. Bot.* VII. (1868), 411; *G. ARBOREUM, Oliver, Fl. Trop. Africa* I., 210-2; *G. HERBACEUM, Maxwell T. Masters, Fl. Br. Ind.* (*in part*) I., 346; *G. HERBACEUM, Duthie and Fuller, Field and Garden Crops of India* I. (1882), 75-8, *t.* 18; *G. PUBESCENS, Splitg., Mart., Fl. Braz.* XII., *pt.* III., 1886-92, 586; *G. ARBOREUM, Engler and Prantl, Pflanzenfam.* III., *n.* 6 (1895), 52, *f.* 25 (*after Parl.*); *G. NEGLECTUM, P. V. Subbiah, Bull. n.* 15 (1901) *of Dept. Agri. U.P. Ind.*, 26, *t.* 1; *G. ROSEUM, Gammie, Class. Ind. Cot.*, 1903, 5, *t.* VI.; *ALIOTTA, Riv. Crit. Gen. Goss.*, 25 (*would seem to regard this as hybrid of G. barbadense* × *G. arboreum*); *G. NEGLECTUM, Gammie, Ind. Cot.*, 1905, 7 (*most of varieties and sub-varieties mentioned*), *t.* VII.

Vernacular names.

In commerce the staple of this plant is known as 'Bengal cotton.' In the vernaculars of India it bears an extensive series of names, being in Bengal and the United Provinces, Central India, Rajputana, the Panjab and Bombay indicated by words or expressions that denote its introduction or describe some peculiarity. Judged of by its vernacular names, therefore, it would seem to be of comparatively recent introduction:—*Bilatee* or *vilayati*, (foreign, see below, under *var. rosea*)—*Khandeshi*; *kateli* (from the beak or thorn on the seed); *mathi* (from the resemblance of the leaves to those of *Phaseolus aconitifolius*, &c.). Buchanan-Hamilton collected it at Nathpur, Bengal, in 1810, where it was called *tipki*. The name *jari* was possibly, as Professor Middleton suggests, originally

No. 11. GOSSYPIUM ARBOREUM, *LINN.* VAR. NEGLECTA, *WATT.*

Photographic reproduction of the Kew Gardens copy of Roxburgh's original MS. illustration named "1493 (1495) Gossypium herbaceum, W."; preserved in the Herbarium Library, Royal Botanic Gardens, Calcutta.

given to a lower grade *bani*, with a strain of the present plant (by hybridisation), but recently pure *var. neglecta* has been called *jari*. In Bengal, Assam, and the United Provinces this is *deshi* or *desi* cotton, and in some localities has specific names, such as *kherdya* of Lohardagga, &c., and a special race, the famous 'Dacca cottons.' The idea of recent introduction confirms, in some measure, the story told above, under *var. sanguinea*, and presently to be upheld under *var. rosea* (**see Plates Nos. 10, 11 and 12**).

Description. A large pyramidal bush, chiefly grown as a field crop, though sometimes hardly more than 18 inches in height. *Stems* very often reddish-coloured (especially so in the finer grades of Dacca cotton). *Leaves* somewhat leathery, but rather thin, though coarse-looking, and often rigid and the lobes furrowed and corrugated; lobes 3-5-7, with the supplementary teeth often within the sinuses appearing on the base of the central lobe; lobes linear-lanceolate, undulate, the bottom pair spreading square or almost backwards, acute, rarely bristle-tipped, densely coated with long spreading hairs, with below these a coating also of stellate hairs. *Inflorescence* short lateral shoots, 2-4-flowered. *Flowers* mostly two together on very short pedicels, yellow with purple centres, or yellow to white with a purple tinge, often never fully expanded, convolute. *Bracteoles* very large, with greatly developed lateral (basal) ears, ovate-acute, toothed, more than half the length of the corolla. *Fruit* (boll) ovate-acuminate, 3-4-celled. *Seeds* small, beaked, with a brownish or greenish fuzz and a large quantity of coarse, harsh, woolly, and very short staple. (**See Plate No. 11**, which reproduces Roxburgh's MS. plate—the most prevalent type of Bengal cotton, and confer also with *var. rosea* below.)

India. *Habitat.*—Cultivated throughout Bengal, Assam, and the United Provinces, less abundant in South India and Burma, distributed by cultivation to China, Africa, the West Indies, and the United States. The names given to this plant, and the traditions of the people of India regarding it, suggest its having originated in the drier tracts of the Gangetic basin. Recently it has been carried to all the regions where the perennial cottons (presumably of *G. Nanking* origin) formerly prevailed, and the unfortunate demand for a short, cheap, staple has even occasioned its cultivation in Gujarat and Kathiawar—the home of what may be characterised as the long-stapled cottons of India.

Short cheap staple.

Citation of Specimens.—The following characteristic specimens can be seen in Kew and other Herbaria:—INDIA (enumerated from north to south): Duthie, Tirah Exped., 1897; also Ushtarzai, n. 20,826; Jameson, n. 15, Amballa, 1849; *katel* cotton of Akola, grown in Saharanpur, Bot. Gard., in 1891; *belaiti* cotton, from Amraoti, grown at Saharanpur; Monro, n. 73, from Hazara; Duthie, Kheri district, n. 21,604; Herb. Ind. Or., Hook. f. and T. T., Moradabad, 1844 (a very hairy example); Royle, *G. arboreum*

and *G. neglectum* on same sheet, also a specimen, very hairy, that seems a cross between *G. neglectum* and *G. Nanking*; Keenan, Cachar, 1874 (a semi-glabrous example, with on label 'appeared wild at Rungpore,' seems as if an acclimatised form of *var. assamica*); Kookee cotton, Cachar; Roxburghian specimens named *G. hirsutum* and *G. herbaceum*, both on one sheet, ex herb. Forsyth (see Plate No. 10, A and B); Wall. Cat., n. 1881b (ex herb. Russell); Hooker, n. 65 (from Sikkim, alt. 4,000 feet, 1848); Griffith, n. 99 (see 'It. Not.,' p. 8). China: Fortune's n. 116a is possibly a hybrid with *G. Nanking*. Africa: Fisher's n. 197 (in the valley of Fatine in 1837—approximates to *var. sanguinea*—staple much superior to the corresponding Indian plant). Philippine Islands, collected by H. Cuming in 1841 (n. 1647) (duplicate in Camb. Herb.). America: Jenman, n. 5785, from British Guiana, also a sample supplied by the U.S. Dept. of Agri. (see below).

In the British Museum:—Sloane Herb. (Miller), (original locality not stated, but said to be 'gathered in Chelsea Garden'), vol. 228, f. 20; also a specimen named *G. hirsutum* in Roxb.'s own writing, with on reverse of sheet, 'Ind. Or. Dr. Roxb. (ex America, introduced)' (see Plate No. 10 C); ex herb. Russell, Ind. Or.; var. ? approaching *neglecta*, Banks and Solander, Java, 1770–71.

In the Edinburgh Herbarium the following are worthy of special record, even though mentioned already:—From Bengal: Dr. Francis (Buchanan) Hamilton's samples, n. 1553, from Nathpur, Bengal (named '*Gossypium* (*Tipki*) *viridescens, herbaceum*'), n. 1552, from same locality (named '*G. viridescens, hirsutum*'); an excellent example from Dr. Wright (ex herb. Balfour); and from Shanghai, China, a hybrid collected by W. R. Carles in 1881.

In the Cambridge University Herbarium the following specimens are interesting:—India: collected by 'Catherine Lyell,' in 1851, cult. between Agra and Meerut; a Serampore specimen, by 'W. G.' (= Griffith).

In De Candolle's Herbarium, Geneva, there are a few examples of this variety, such as Wight, n. 179, and one collected by Fortune, in China, in 1846—perhaps a hybrid *neglecta* × *nanking*.

In the Economic Herbarium, United States Department of Agriculture (selection of samples sent for my inspection), there is a specimen of this variety described as grown from Japanese seed (n. 606).

In the Herbarium R.E.P., Calcutta, a series some of which approach near to typical *G. arboreum*:—nn. 1747–8, Bhavnagar, Kathiawar; 1780–3, from Verawal; 1793, Mangrol; and 1794, Ranpuri cotton from Mangrol; also specimens from Poona and Kirkee Farm, nn. 21,814 (*jari*); 21,895 (*deshi*, Ambala); 21,896 (*nurma*, of Multan); 22,006 (Cuttack) and 22,010 (*won* of Saugor); *katel* and *belaiti*, cult. at Saharanpur Botanic Garden.

Rheede's Malabar cotton.

Nomenclature.—In point of historic sequence, the earliest botanic reference to this plant would appear to be that in the 'Hortus Malabaricus' (1686), thus associating it with India, the headquarters of its present-day cultivation. Rheede there speaks of it as a shrub, 10 to 12 feet in height, found growing in sandy places. But as if to remove the possibility of its being supposed to be *G. arboreum*, he carefully describes the long narrow segments of its smooth soft

leaves, then adds that the flowers are pale yellow with purple claws, and the seeds have a white to grey fuzz.

Buchanan-Hamilton, who wrote (in 1822) a commentary on Rheede's great work and had himself visited Malabar, observed that, so far as he had seen in that district, cotton was raised (as Rheede had described it) by the Natives, in the form of small trees planted in corners of gardens, and not in fields, nor was the cotton for sale. But Buchanan-Hamilton, unfortunately, had come to the conclusion that all the cultivated cottons of India were mere races that differed from each other 'vastly less than do the varieties of the cabbage.' He thus did not allow himself to realise that, even accepting so restricted a botanical view, they might still be of great agricultural and commercial value, and, therefore, worthy of separate recognition. Accordingly he omitted to add that the cotton of Malabar might be described as a perennial state of the self-same plant to which he had at one time assigned the name *G. viridescens*. On the other hand, Roxburgh, commenting on Rheede's *Cudu pariti*, observed that he could not bring himself to believe that it was *G. arboreum*. The fact that it was a small tree, and thus a perennial, precluded him, apparently, from assigning it its true position along with the 'Bengal (Dacca) cottons,' to which he most unfortunately gave the name *G. herbaceum*.

Agricultural value.

Two specimens in the Kew Herbarium, that may be accepted as having been procured from Roxburgh, are named *G. herbaceum* and *G. hirsutum* (see **Plate No. 10, A and B**). Both are, however, the same plant, and they match almost exactly Buchanan-Hamilton's n. 1553, *G. viridescens var. herbacea* (*Wall. Cat.*, 1880, *b*), and n. 1552, *var. hirsuta* (*Wall. Cat.*, 1880, *a*); they are very nearly indistinguishable from each other, and are typical examples of the races of the plant here discussed. In Hamilton's sets, the first (1553), to which he gives the vernacular name *tipki*, might possibly be spoken of as a transitional form approaching his red-flowered cotton (n. 1549) already mentioned. Hamilton regarded it as being *G. herbaceum, Roxb.*, (*Hort. Beng.*, 51), and commented on it, '*Colitur in Mithila agris.*' The second (n. 1552) is without any doubt the plant, since named *G. neglectum, Tod.*, which Hamilton identified as *G. indicum, DC., Prod.* I., 456; and as *G. hirsutum, Willd., Sp. Pl.* III., 805. On the label of that sample he observes '*Colitur in Mithila arvis.*' He certainly could not have so described it had it been in 1810, as it is to-day, the most abundant and most

Hamilton's Bengal cottons.

widely distributed form of cotton in India. But now comes the greatest puzzle of all. In the British Museum Herbarium there is a specimen of this very plant, named *G. hirsutum* (apparently in Roxburgh's handwriting), which bears on the reverse of the sheet on which it is mounted the remark (in other handwriting): 'India Orientalis Roxburgh (ex America, introduced).' (That specimen I reproduce on **Plate No. 10 C**, as also its labels.)

Okra cotton.

In 1895 I had the pleasure to receive a most valuable series of botanical specimens of the cottons cultivated in the United States of America, contributed by several authorities. In one of the sets I found a specimen of this very plant which bore on the label the name *Okra*. This interested me greatly, hence I asked Mr. Tracy, of the Mississippi Agricultural Experimental Station, from whom it had been received, for further information. He most kindly replied: 'The *okra* cotton which you mention as being one of the forms of *G. neglectum* has always puzzled me. My notes regarding it are as follows:—This is one of the older varieties mentioned by southern writers as early as 1837, when it was quite common and somewhat popular, but soon disappeared. In 1870 Dr. C. A. Alexander, of Washington, Ga., found a single stalk in his fields, and from its product it was again disseminated quite widely from 1885 to 1890, but its culture is less general now than five years ago. The plant is of medium growth, limb short and upright, leaves with very narrow lobes; bolls clustered, small, round, and maturing early; lint 32–34 per cent., staple 24–26 mm.'

Historic records.

The explanation of this most interesting and valuable historic note would appear to be that, when the United States began to consider the desirability of cultivating cotton, the East India Company not only conveyed to them Turkish (which we know they did) but also Indian seed. Hence, just as Siam cotton from Louisiana was spoken of by Cavanilles as American, so a sheet of this peculiarly Indian plant has come somehow or other to bear in the British Museum the note 'Ex America (introduced).' In support of this view it may be pointed out that Purchas ('Pilgrims' iv., p. 1784) furnishes an interesting statement of the provisions sent to the Colony of Virginia by the Right Hon. Henry, Earl of Southampton in 1621. There we read of the 'Plants of Cotton-wooll trees of the West Indies' and 'of the cotton-wooll seeds from the Moguls countrie.' Rohr ('Observ. sur la Cult. du Cot.' Fr. ed. 1807, p. 62–64) also tells us that he obtained, in 1785, seed of a cotton

procured through M. Chemnitz, of Copenhagen, from a M. John, of Tranquebar in Madras Presidency. This, Rohr cultivated in his plantation in Sainte-Croix (Santa Cruz) in the Antilles. He classified it as one of the forms of cotton to which he gave the name of 'Nun's Cotton'; a second Nun's Cotton also came from India, namely from Cambay. It is interesting to add that Rohr, though he cultivated these experimentally, and at the same time Siam cotton (*G. Nanking*), did not think it necessary to suggest that the three plants named were in any way specially related to each other. Tranquebar cotton.

There can thus be no doubt that Indian cottons were at an early date introduced into the West Indies and into the United States of America as well, and therefore very possibly this particular form, as also the far-famed Dacca cotton, stands every chance to have been carefully investigated in the New World. But the fact that *G. arboreum, var. neglecta*, has preserved in the United States, during probably close on 300 years of cultivation, identical characteristics to those it possesses under the widely different environment of India, argues strongly against the structural peculiarities by which it is recognised being viewed as merely geographical and climatological features, that change or disappear under altered conditions. Survival in the United States.

In passing it may be here added that a perfectly distinct plant, though in external manifestations one that resembles *G. neglectum*, has recently been sent me from the Department of Agriculture in the United States, under the name '*Okra*,' but with a totally different history. It has been supposed to be a natural sport from a form of *G. hirsutum* known as King's Improved. The plant to which I allude may be seen on **Plate No. 39**, and its supposed original stock on **Plate No. 31 B.** In this connection also a reference may be made to *G. pubescens, Splitg.*, which Schumann, (Martius, 'Fl. of Brazil') speaks of as grown in gardens in Surinam. There would seem hardly any doubt that the plant indicated is *G. arboreum, var. neglecta.* Lastly, Macfadyen ('Fl. Jamaica') speaks of his *G. oligospermum* as found on 'waste places, Liguanea.' This plant having been thus carried to the New World, it is not difficult to believe that the close relationship and intercourse that existed between India and the West Indies, for a couple of centuries or so, might easily have resulted in cottons, sent originally from India, being again returned later on, from the belief that they were West Indian if not American, and possibly, therefore, worthy of cultivation in India. In part support of this view it may be added Carried to the West Indies.

it is very significant that with the older botanical authors, down to and including Linnæus, most of the cultivated cottons of the world have been given the habitat of 'America.'

Survive for centuries.

But with reference to the survival of this presumably Indian plant in America and elsewhere (after its cultivation had been abandoned), it may be observed that, once a particular species or race of cotton had been introduced into a favourable cotton-growing country, even though its regular cultivation might chance to be discontinued, it would be no great stretch of imagination to believe that a specially hardy stock, such as the present plant, might survive for centuries. It might appear and disappear, here and there, according as it aroused attention (and was reinvestigated) or caused a fresh effort to be put forth for its eradication. This is the history of many weeds of cultivated land the world over. Some such explanation of the sudden appearance of new stocks is preferable to the alternative theory that they had originated sporadically from remotely different plants. But again if belief be put in the value of crossing, in the production of races of cotton, the well-known behaviour of recessive splitting forms might readily account for the seeming spontaneous origin of widely different plants. The fact, however, remains that *G. arboreum var. neglecta* has been repeatedly recorded as met with in the United States of America, and in the examples seen by me the plants in question could not possibly be separated botanically from the corresponding Indian stocks.

Recessive forms.

In this connection also it may be added that through the generous co-operation of Mr. B. T. Galloway, chief of the Bureau of Plant Industry in the United States of America, I have been able to examine herbarium specimens of the cotton plants at present being experimentally cultivated at the Testing Garden, Washington. Among these is one described as 'Japanese Wool,' raised from seed procured from Japan. This is almost in every respect identical with the Bengal plant already fully detailed. The young leaves, however, are perhaps a little more softly pilose than is customary in India, and the veins below manifest very frequently three in place of only one gland. It is thus very possibly slightly hybridised with *G. Nanking*.

Japanese stock.

Superior staple.

Race—Dacca Cotton.—Perhaps the most significant feature of the story of *var. neglecta* is the circumstance that, while it to-day affords the most inferior grades of Asiatic cottons, at one time it

No. 12. GOSSYPIUM ARBOREUM, *LINN.* VAR. NEGLECTA, *WATT.*
(DACCA COTTON.)

Photographic reproduction of the Kew Gardens copy of Roxburgh's original MS. illustration named "1494 (1496) Dacca Cotton, a variety of Gossypium herbaceum"; preserved in the Herbarium Library, Royal Botanic Gardens, Calcutta.

seems to have yielded several very superior staples. There would appear little doubt that the red-stemmed plant, described and figured by Roxburgh as the much-talked-of 'Dacca Cotton,' and which Todaro named *G. Roxburghii*, is in reality but a special race of *neglecta* produced, and possibly to-day still grown, within a very restricted tract of Eastern Bengal.

Roxburgh's picture.

I have thought, therefore, it might serve a useful purpose to reproduce here (by the three-colour process of photography) Roxburgh's original plate of the 'Dacca Cotton' plant. **(See Plate No. 12.)** This was published by Roxburgh in his 'Plants of the Coast of Coromandel,' but the reproduction is from the Kew copy of the original MS. coloured drawing. I am enabled to give this, through the kind permission of the Director of the Royal Botanic Gardens, Kew, and although the reproduction is a little less than one-half the original (which is presumably life-size), it conveys a full conception of the structural peculiarities of the plant and manifests a form which, if it exists at all, can hardly be said to be a regular crop in India—it is in fact unknown to me.

Early Opinions.—In view of the efforts at present being made to develop the industry of cotton cultivation in Bengal, it seems desirable that the opinions of the earliest writers on the Dacca cotton should be briefly indicated.

Two crops, 1788.

Luillier ('Nouv. Voy. aux Grandes Ind.' 1726, p. 51), speaks of large quantities of cotton in Bengal that grow to the height of three feet. Mr. Bebb, Commercial Resident of Dacca, furnished a reply to an inquiry made by the East India Company, and that is one of the earliest authentic accounts of the Dacca race (in fact of Bengal) cotton. His report is dated 1788, and speaks of the staple as 'the finest cotton in the world, producing cloth of astonishing beauty and fineness.' He tells us that the plant was an annual, of which two crops were obtained in the year, in April and again in September. The first was the most esteemed and fetched the highest price, but was liable to failure from long drought or from violent storms, though moderate showers were highly beneficial. Rohr and many other writers allude to their experiments with the cultivation of muslin cottons, so that there is no doubt the plant was carried to the West Indies and to both South and North America fully a century ago, perhaps as an outcome of the Company's investigations.

Roxburgh's

Dr. Roxburgh, who was appointed Superintendent of the Royal Botanic Gardens of Calcutta in 1793, early gave attention to this

investigations in 1793.

special Dacca cotton (see Royle, *l.c.* p. 245). In the volume of reports on Cotton, Silk and Indigo, published by the East India Company in 1836, there is a report written by Mr. Henry St. George Tucker in 1829, 'On the Supply of Cotton from British India,' in which (pp. 159–60) he discusses the superior cotton of Dacca. He calls it '*Bairati kapas*, the finest variety, perhaps, of the Eastern cotton, is produced only in small quantity in the districts north-west of Dacca, and is never exported I believe as an article of commerce. Its favourite site seems to be the high banks of the Ganges' and its tributaries. 'The fibre of the *Bairati* is extremely fine, silky and strong, but the staple is *very short*, and the wool adheres most tenaciously to the seed.' It is 'admirably calculated for the manufacture of the muslins and thinner fabrics, but has the disadvantage of a short staple.' It is 'perhaps too costly a production to enter largely into our manufactures.' Mr. Tucker adds that he sent the seed of this plant to his native island, Bermuda.

Tucker's account, 1829.

Dr. Roxburgh, 'Flora Indica,' gives the points of difference between Bengal and Dacca cotton. The plant is more erect, has fewer branches, and the lobes of the leaves more pointed. The whole plant is tinged with red, even the petioles and nerves of the leaves, and it is less pubescent. The peduncles of the flowers are longer, and the exterior margins tinged with red. The staple is longer, much finer, and softer. Dr. Roxburgh's MS. drawing (**see Plate No. 12**) manifests all the special peculiarities mentioned, and thus doubtless faithfully represents the plant, but Roxburgh adds that the people of Dacca think, the *great difference lies in the spinning*, and allow little for the influence of the soil.'

Hamilton's description, 1828.

Colonel D. Prain, F.R.S., Director of the Royal Gardens, Kew, published in the Annals of the Botanic Gardens, Calcutta, a most instructive 'Sketch of the Life of Francis Hamilton (once Buchanan),' from which the following passage may be abstracted from a letter to Wallich in November 1828, some years after he had left India, and which affords most valuable imformation regarding the superior grade Dacca cotton, one hundred years ago: 'What grows on the plains, especially to the north-west of Dacca, is vastly superior, and I beg to call your attention to the report which I have made on the cultivation of that kind in my report on the agriculture of the Dinajpur district, which you can readily procure at the India House. A small portion of the country favourable for the fine cotton extends into the south-east corner of the district, and is distinguished by being

sufficiently high to escape inundation and by having a considerable portion of strong clay in its composition.' . . . 'I have no doubt that the fine cotton produced near Dacca is one cause of the superiority of the manufacture, nor do I think that any American cotton is so fine, but then there can be no doubt that the American kinds have a longer filament and on that account are more fitted for European machinery. I think, however, that if the good Dacca cotton were sent home, which I do not suppose has ever been done, that our people would contrive to spin it and find it superior to any other; and the first experiments to be tried on the subject should, I think, be directed to that quarter' (*l.c.* p. xxxv).

Taylor's story, 1851.

In support of Dr. Buchanan-Hamilton's opinion of the Dacca cotton, mention may be here made of Dr. James Taylor's pertinent remarks, fifty years later ('Descriptive and Historical Account of the Cotton Manufactures of Dacca,' published by John Mortimer in 1851). Speaking of the fineness of the thread, Dr. Taylor says that 'a skein which a native weaver measured in my presence in 1846, and which was afterwards carefully weighed, proved to be in the proportion of upwards of 250 miles to the pound of cotton.' Dr. Taylor then goes on to explain that the shortness of the Dacca cotton renders it unsuited to machine spinning, but nevertheless the local muslin spinners were *unable* to use the American cotton, which was given them for experiment, and claim that the local fibre is superior for that purpose. (Cf. pp. 29 and 37.)

Present day inferior.

'Formerly, when this article was more extensively cultivated than at present, there were different shades of quality observable in the staple, which either cannot now be distinguished or have degenerated into one of an inferior degree. They were known by the names of *phootee*, *nurmah* and *bairaite*. The cotton of the present day, it is affirmed by the natives, is inferior to what it formerly was. The crops are less abundant, and it is said that the fibres, though apparently equally fine and soft, are shorter and more firmly adherent to the seed than the produce of former years. The Dacca cotton, however, notwithstanding the deterioration imputed to it, still ranks as an article of finer quality than the produce of other parts of Bengal or of the western provinces' . . . 'The seeds, which are used for sowing, are carefully picked, and after having been dried in the sun are preserved in an earthen pot in which oil or *ghee* has been kept, and the vessel with its mouth stopped up, so as to exclude the external air, is hung up to the roof of the hut, and over the spot where

Seed preserved in oil.

the fire is usually kindled. The high lands are selected for this crop, and are ploughed from eight to twelve times up to September and October, when the seeds are sown. This is done in parallel rows, distant about a cubit from each other, and before the seeds are dropped into the ground they are moistened with water. The cotton plant is liable to injury from hailstorms, heavy rain, and caterpillars.' 'Formerly the ground for cotton was allowed to lie fallow every fourth year, and it appeared to be owing to the neglect of this circumstance in the present day that the produce is now inferior in quality to that of former times.'

Sowing in October.

Swelling fibre.

'The cotton of the northern division is said to swell less than the produce of other parts of the country. This tendency of the fibre to swell in bleaching is the criterion by which the weavers judge of its quality, but whether it depends on any inherent property in the cotton itself, or on the water used in the bleaching, is not known, though there is reason to believe that it is principally owing to the latter. The thread manufactured at Dumroy, which was reported by Mr. Bebb, the Commercial Resident, to swell the most, is found by the weavers at present to be equal to the thread of the best *aurungs* or to swell the least if bleached in Dacca, but the reverse, as Mr. Bebb describes it, if the water of Dumroy be used in the process.'

British Cotton-growing Association.

Recent Opinions.—At a conference held at Manchester, by the British Cotton-growing Association (reported in the 'Manchester Guardian' of June 11, 1903), I was invited to address the meeting on the subject of Indian-grown cottons. In the course of my remarks, I drew attention to the subject of Dr. Taylor's observations regarding the short-staple annual cotton plant of Dacca, from which the far-famed muslins of that town were made. In the passages above I have reproduced the more important statements from Taylor's 'Descriptive and Historical Account of the Cotton Manufactures of Dacca,' and the reader who cares to do so may thus verify the brief description given by me at Manchester. I should not have alluded to this subject, however, had not my accuracy been called into question by Mr. G. Greenway, of Calcutta, in a long letter which appeared in the 'Manchester Chamber of Commerce Monthly Record' (dated September 30, 1903). I venture to think that a meaning has been given to my brief extempore utterances that I neither intended nor think are implied by the words which I actually used. All I wished to imply was that perhaps the Dacca hand-spinners might still be able to teach the

machine-spinners something worthy of their attention. Whatever explanation can be given of the fact, a fact it remains, that the hand spinners of Dacca use a short-staple annual cotton (not a long-staple tree cotton) in the production of their exceedingly fine muslin yarns. And, moreover, Dr. Taylor tells us that when given the very finest imported American long-staple cotton, the Dacca spinners failed to produce from that as fine a yarn as they could from their own short-staple floss. Hand *versus* machine spinners.

An American acclimatised long-staple cotton has, it would seem, been recently discovered in Bengal. But the inference has been a little too precipitately drawn that that plant was the far-famed Dacca muslin cotton. Its discoverer speaks of it as a long-staple tree cotton, while from the above extracts it will be seen all the early writers, such as Rohr, Buchanan-Hamilton, Bebb, Tucker, Roxburgh and Taylor, allude to the muslin (or *bairati*) cotton as having been a short-staple annual plant. Tree cotton in Dacca.

But the question may be asked, 'Is it or is it not a fact that with an exceedingly short staple the Dacca manufacturers are *still* producing (or until very recently were producing) muslins which, if not up to the old standards, are certainly far finer than could be manufactured from the staples they use by any process or machine known to-day in Europe or America?' Dr. Taylor says, 'The material of which the fine Dacca muslins are made is entirely the produce of the district. The plant is an annual one, and attains a height of about five feet.'

Lastly, Mr. A. C. Sen ('Rept. on Agri. and Agri. Stat. Dacca,' 1889, p. 52) observes: 'The cultivation is not now done half so carefully as was the case at the time of Dr. Taylor. The field is prepared by two to four ploughings and as many harrowings. Furrows are then drawn a cubit apart and in these furrows cotton seeds previously moistened with dung water are dropped in thickly. When the plants come out they are thinned to a distance of a foot from one another.' Present-day cultivation.

It thus seems probable that the interest in the Dacca muslin cottons may turn on a more careful investigation of the methods of spinning pursued by the hand workers. And it is just possible this may prove suggestive of new developments. My experience of the Indian craftsmen would lead me at all events to study critically their methods and theories, especially regarding the hygroscopic properties of certain cottons and the chemical composition of the well waters used by them, rather than to speculate whether or not the botanists Future investigations.

of the past century have been in error as to the plant grown for the muslin industry of Dacca—a locality famed for its cottons for perhaps the past 2,000 years.

Garo Hill cotton.

13. Var. assamica, *Watt:* *G. (?) CERNUUM, Tod., Osser. su Tal. Sp. di Cot.* 31*; C. Mül., Walp. Ann. Bot.* VII. (1868), 411*; Darrah, Note on Cotton in Assam,* 1885*; Middleton, Agri. Ledger No.* 8, 1895, 19–20*; Dict. Econ. Prod. Ind.* IV., 141–2.

Garo Hill cotton; *Kil* or *Borkapah* (large cotton), *Soru kapal, Khungi deva,* &c.

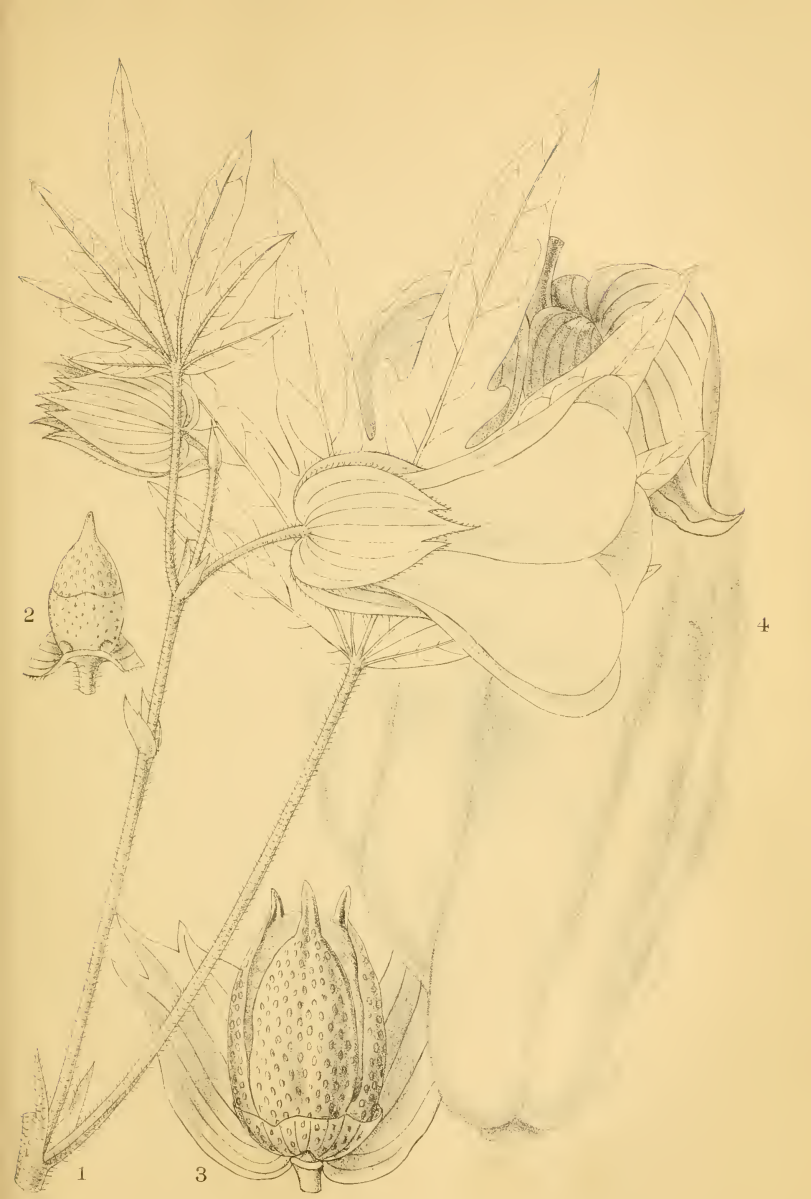
Description.

This very remarkable cotton might fairly well be described as an extreme form or special race of *var. neglecta.* It is raised as an annual crop. *Leaves* soft, thin, very hairy, borne on exceptionally long leaf-stalks, which are sometimes as much as 4 to 8 inches in length, or twice the length of the leaves; leaves deeply cut into 5 to 9 (mostly 7) lobes, which radiate upwards from a narrow and only very slightly cordate base, central lobe often once or twice toothed near the sinus, but ribs eglandular. *Inflorescence* on long axillary naked peduncles, and bearing 2 to 3 flowers on short pedicels; *bracteoles* relatively small, ovate acute, 3-dentate or subentire, accrescent and much enlarged on the fruit. *Flowers* fully twice the length of the bracteoles, pale yellow to white. *Capsule* much the longest of any species of the genus, the protruding mass of seeds often attaining a length of 6 to 8 inches (f. 4), each mass with 15 to 20 seeds, free from each other but firmly bound through the interlacing of their wool. *Seeds* large, flattened, beak sharp, fuzz abundant and whitish-brown, floss short, white, very coarse and woolly (see Plate No. 13, ff. 1–4).

India.

Habitat.—This plant is a special feature of the Garo and Mikir Hills and to some extent also on the plains of Assam (Nowgong, Golaghat and Kamrup, &c.); not seen in any herbarium except from Assam.

Citation of Specimens.—Masters collected it many years ago and sent samples to the Agri-Horticultural Society of India, and one of his samples is in the Kew Herbarium. Captain A. T. Gage (Superintendent Royal Botanic Gardens, Calcutta) has just sent for my inspection a selection of the specimens in the herbarium of that institution. Among these is a long series of this plant collected by Masters, Jenkins, McClelland, and others. The samples collected from the plains of Assam manifest a transition into both *var. neglecta* and *var. rosea,* though all preserve the softly hairy condition of the original Garo plant. An excellent specimen of this variety is in the Edinburgh Herbarium, contributed by Dr. Jameson from Saharanpur. It is thus known to have early found its way to the Saharanpur Botanic Gardens. In consequence many of the examples of *var. neglecta,* as also the *G. Nanking var. bani,* and other cottons grown in these gardens, would appear to have been hybridised with the Assam plant. Of this nature may be mentioned the *belaitee* of Amraoti and the *jadi* of Akola, as recently issued



M. Smith delt, J. N. Fitch lith.

West, Newman imp.

No. 13. GOSSYPIUM ARBOREUM, *LINN.*, VAR. ASSAMICA, *WATT.*

1, Portion of flowering shoot; 2, young fruit and calyx with glands; 3, mature fruit and bracteoles; 4, boll of cotton.

from these gardens. Gammie and others allude to an acclimatised Garo Hill stock being found in Nagpur (see R.E.P., n. 22,031). Accepting that history as correct, the plant can hardly now be distinguished from *var. rosea* or even from the ordinary *var. neglecta*. The most striking eye-mark, however, for the Garo plant proper is the softly hairy leaves, borne on exceptionally long leaf-stalks, and with the lobes radiating forward. Acclimatised stock.

Nomenclature.—The people of the Garo Hills produce a peculiar kind of blanket, formed by rows of the tufted wool of this plant being placed by hand across the fabric and bound in that position by the weft forced home on each successive row of tufts. Whether that peculiar textile suggested the selection that has resulted in the production of the Garo Hill long-boll cotton it would, of course, be impossible to say. The floss, though abundant, is of little commercial value except, perhaps, to mix with wool. When carried to other parts of India (even to the plains of Assam) the plant throws off many of its characteristic features, is rapidly crossed with other stocks, and soon becomes what can best be described as a large form of *var. neglecta* or at most of *var. rosea*. It is probable, however, that this is actually the plant Todaro meant to indicate by his *G. cernuum*, but if so his description is most unsatisfactory, and the plant cannot possibly be more than a variety, if not rather a special race. It is certainly not a species. There is thus nothing to justify the retention of the name *G. cernuum*, hence my giving it the name *assamica*, to denote its original locality of production. Garo blankets.

It may be only a coincidence, but Rohr ('Observ. sur la Cult. du Cot.,' 1807, pp. 45–46) describes a remarkable cotton under the name 'Carthagena cotton with long boll.' This, he says, was the largest tree of all the cottons known to him, and the bolls were 7 to 8 inches in length. The cotton was, however, not desired in Europe, and so its cultivation was not attempted in Sainte-Croix. Of course it is not likely to have been *var. assamica*; but since a South American cotton with a boll of the size mentioned has been referred to by no subsequent writer, I have thought it desirable to furnish here this brief reference to it. Long-bolled cotton.

Cultivation

Mr. H. Z. Darrah, in an interesting 'Note on Cotton in Assam' (1887), affords much useful information regarding the cotton of that province in general, and of the present form of cotton more especially. He shows that in the plains districts of the Brahmaputra and Surma valleys cotton was little grown, but that on the Area.

hilly tracts 'cotton nearly everywhere becomes a staple crop.' He further shows that the Garo Hills alone possessed, in the year under review, 22,933 acres out of the provincial total of 38,815 acres. He divides the cottons grown into two groups—'large-bolled' and 'small-bolled'—and under the former includes the *kil* of the Garo Hills. Of that special cotton he says 'it is grown everywhere on the hillsides, and is not confined to level ground, but can only be plucked once a year. The pods are very large, sometimes as much as 8 inches in length, and when they burst the contents come out in a cataract of cotton, which gives a field the appearance of being covered with snow. This variety is, however, not as much in quest for ordinary purposes as the smaller kind. The fibre is said by the trade to be harsh and to twist badly. It is better adapted for mixing with wool than for any other purpose.'

A field of snow.

'Cotton is most generally grown on forest clearings known as *jhums*.' 'The soil should be calcareous and the situation sunny.' 'In the Garo Hills a species of small bamboo grows with great luxuriance, and the soil on which it is found is invariably selected if the other conditions for cultivation are favourable. No manure is ever used, except the ashes of the burnt jungle.' 'The land is never ploughed for cotton, except in the few places where it is grown in the plains.' 'The hill men always use the hoe, as the slopes on which cotton is grown are too steep for cattle to be employed.' 'The jungle is usually cut in the cold weather and allowed to dry on the ground. It is burnt in March or April, and then, as a rule, hoed. As soon as possible afterwards the cotton is sown.' The yield is said to have been ascertained to be 507 lbs. uncleaned and 260 lbs. cleaned cotton per acre.

Garo cultivation.

The above passages convey the chief ideas made known by Mr. Darrah that seem to have a special bearing on the Garo Hills cotton, as seen in its original home—the Garo Hills. I now turn to the reports of its experimental cultivation in other parts of India and its influence on certain recognised stocks. In the citation of specimens, seen by me in herbaria, it will be observed that I allude to numerous samples issued from the Botanic Gardens of Saharanpur which manifest hybridisation of this plant with *bani* and other forms of Indian cotton. Through the kindness of Mr. Leake, Economic Botanist to the United Provinces, I have been furnished with a sufficient supply of these hybrids to admit of my placing a few of them in herbaria, thus providing for future reference. But the

Hybridising stock.

history of these hybrids (or at least of certain of the early stocks) would appear to exist in an official correspondence which I have had the pleasure to inspect, through the kindness of the Director of Kew. In a letter dated May 7, 1870, Major Trevor Clarke addressed the Cotton Commissioner of India on the recent success he had attained in England in crossing 'Assam Hill Cotton' with Hinganghat. Clarke supplied seed of that hybrid to Mr. H. Rivett-Carnac, and we subsequently learn this was distributed for experimental cultivation to Akola and Nagpur, and doubtless also to Saharanpur, since that botanical garden was in close touch with most at least of the cotton experiments of the period mentioned. Moreover, recently, the late Mr. Gollan procured *bani* cotton from Akola and Garo Hills cotton from Assam, and grew them side by side at Saharanpur. He furnished me with samples of these for determination in 1904, and it was then found that he had thus re-performed Major Clarke's experiments in the production of hybrids between the plants named. The so-called acclimatised *kil* cotton of Nagpur might thus easily enough be a survival of the hybrid stock mentioned which had been possibly subsequently again hybridised with *var. neglecta.* The samples of the Nagpur *kil* in my possession are certainly not typical *G. arboreum, var. assamica,* as defined by me, but stand almost intermediate to that plant and the variety that I accept as being Todaro's *G. roseum,* a form very near to *var. neglecta.* In fact, the *varadi* cottons of India are mostly hybrids of that nature.

Trevor Clarke's hybrid.

Nagpur kil.

This suggestion seems worthy of direct verification by fresh cross-breeding experiments with *var. assamica* into *var. Bani.* It may be recollected that Professor Gammie, of Poona, crossed *G. roseum* (*varadi*) with *G. hirsutum* (see his 'Note on Classification of Indian Cottons and Cross-breeding Experiments at the Poona Farm, 1901–3,' p. 15) and obtained a plant of which he remarks: 'This cross is exactly *Bani* of the Central Provinces, which may be accepted as proved to be of cross origin. No other cross resembled any known (to me) form of Indian cotton.' Gammie's experiment is highly interesting, but I fear may have to be given a totally different explanation. It is universally accepted by hybridists that when dissimilar gametes are crossed the resultant is the appearance of an ancient form—the condition called by Darwin a 'reversion.' In Gammie's so-called cross, therefore, we have simply the re-appearance of the more ancient *bani* stock, present (as above indicated) in the *G. roseum* ancestor, and forced into being through

Gammie's hybrid.

Dissimilar gametes.

the exhibition of the remotely different American stock—*G. hirsutum.* Gammie's experiment need not, therefore, prove that the *bani* cottons of India are hybrids between *G. roseum* and *G. hirsutum.* (Cf. with pollen-grains p. 346.)

Caution necessary.

But we have here a useful demonstration, doubtless, of the extreme caution that is on every hand necessary in propounding explanations of existing forms of cotton, until the accumulated definite knowledge has laid a rational foundation in the species and varieties of the genus. So much obscurity prevails that countless experiments, such as those performed by Professor Gammie, may have to be conducted in every cotton-growing country, until the more obvious misconceptions have been eliminated and we are in a position to affirm that a cross between two plants (pure types) will produce such and such a resultant.

Bani = *G. nanking.*

The above experiment therefore with *G. roseum* × *G. hirsutum* seems to me to confirm the belief I have advanced elsewhere that the *bani* cottons of India belong to a perfectly distinct series, the ancestral type of which is *G. Nanking* (Cf. p. 134.)

Varadi cotton.

14. Var. rosea, ***Watt:*** *G. ROSEUM, Tod.* (*aslo G. ALBIFLORUM Tod.*), *Rel. Cult. dei Cot.*, 164–68 *t.* 2, *also Osser. su Tal. Sp. di Cot.* 22; *C. Müll., Walp. Ann. Bot.* VII. (1868), 410; *Nurdki Cotton of Middleton, l. c.* 11; *Aliotta, Riv. Crit. Gen. Goss.*, 18 (*treats this as a hybrid of G. barbadense* × *G. arboreum*); *G. CERNUUM, Gammie,* (*non Tod.*), *Ind. Cot.* 1905, **7**, *t.* VIII., *but exclude synonym of Garo Hill Cotton.*

Varadi cotton, *Katel Belati* cotton, *Nimari* cotton, *Bangai* cotton (Sylhet), and *Nurdki* of Bengal.

Description.

As already suggested, this is in reality but an extreme form (a hybrid, most probably) of *G. arboreum, Linn., var. neglecta.* The leaves are deeply 5-7-lobed; the lobes very narrow, but very long, and almost rotate on the petiole, the bottom imperfect pair of lobes being thrown pedately backwards from the shallow cordate base. Flowers very short, erect, white with purple claws, or white or yellow with a pink tinge, and completely contained within the large bracteoles (**see Plate No. 14 A**, which reproduces Todaro's original picture, and **B**, which shows a typical specimen of the plant).

Citation of Specimens.—The following specimens of this plant may be here mentioned:—Wight, n. 212, from Coimbatore; the *konkho chicao*, R.E.P., n. 22,012; Nagpur-kil, R.E.P., n. 22,029, and 22,031, and the *judi* and *katel* cottons, cultivated at Saharanpur in 1891; Senaar

No. 14. GOSSYPIUM ARBOREUM, *LINN.*, VAR. ROSEA, *WATT.*

(A) Reproduction of Todaro's original plate (Relaz. t. II.); (B) specimen in Wight Herb. n. 212, from Coimbatore.

cotton, n. 213–1, contributed by Mr. Lawrence Balls, Khedivial Agricultural Society's Laboratories, Cairo.

Varadi cotton.

Nomenclature.—When shown a typical example of this plant by itself, there is little difficulty in admitting it to a varietal position. But when the study is extended to the cotton fields it is found that the transition into the ordinary form of *var. neglecta* is so gradual and continuous that it becomes impossible to separate the two. In fact the so-called acclimatised Garo Hill cotton of Nagpur, so far as the specimens seen by me indicate, might perhaps better be described as the present plant rather than as a form (hybrid) of *var. assamica*. The cultivators of India, being familiar with the normal condition of *G. arboreum* and of *var. neglecta*, had brought to them this robust and hardy plant, with its small pinkish-white flowers and large bolls, to which they at once gave distinctive names, such as those mentioned above. It is the most inferior of all Indian cottons, though the most prolific yielder. The advance of the *varadi* cotton across India might be said to have been, some few years ago, regularly chronicled from district to district, and hailed as a treasure by the advocates of low-grade cottons and viewed as a calamity by others. Professor Middleton says: 'White-flowered cotton is a dangerous rival to the finer varieties. By nature it is made to supplant. When brought to a new locality, instead of pining, as most exiled cottons do, it develops all its best properties, grows robust, matures early, is prolific, and so wins the favour of the cultivators; once established, it begins to degenerate, joins company with the worst of the native varieties, and forms the mixed growths that constitute the bulk of the "Bengals" of commerce.'

Trevor Clarke's hybrids.

It is thus most curious that the name *vilayati* (English) should be often given to this plant, as also to several of the more robust forms of *var. neglecta*. That name would seem, in fact, almost suggestive of Major Trevor Clarke's endeavours to cross the immensely prolific *var. assamica* with the Hinganghat silky cottons (see pp. 111, 336), the name being thus expressive of the actual origin of at least some of the special stocks to which it is given. Wherever met with, throughout India, it is almost invariably associated with Khandesh and Berar, and only began to attract attention about the very time of the introduction into those provinces of Major Trevor Clarke's cross-bred stocks. If this suggestion proves correct, it would thus come about that the first direct effort at cross-breeding Indian

cottons had given to the Natives their most prolific, but most inferior, short-staple plant.

Senaar tree cotton.

I have just had the pleasure to receive from Mr. Lawrence Balls, of Cairo, a specimen of what he describes as Senaar tree cotton. This proves to be a distinct race, but one which seems to fall most readily under the present variety. Leaves thick, leathery, smooth, glabrous, deeply lobed, the lateral sinuses often having extra teeth, and gland-dots very conspicuous, almost forming warts, along the petioles and midribs. Flowers very small, yellow with purple flush, almost contained within the bracteoles. Fruit 3-celled, bursting horizontally, and throwing out the cob of seeds and wool, the seeds being much separated. Seeds large, coarse, with rusty fuzz; wool scanty, rigidly spreading, much twisted, silvery-white, but harsh.

Chinese cotton.

15. **G. NANKING**, ***Meyen,*** *Reise*, II. (1836), 323, *et Verh. der Gartnb. der Preuss. Staat.*, XI., 258, *t.* 3; *G. FRUTESCENS PENTAPHYLLOS, Plukenet, Alm. Bot.*, 1696, II., 172 *Phyt. ? t.* 299, *f.* 1; *Volkamer, Nürnberg. Hesp. (Contin.)*, II. (1714), 235–6, *? t.* 236; *GOSSYPIUM, Capas, Rumphius, Herb. Amb.*, IV. (1750), 33–37, *t.* 12; *G. INDICUM, Lamk., Encycl.* (1786), II., 134 (*G. ? MICRANTHUM, Cav., Diss.*, 1785–90, 311, *t.* 193); *G. HIRSUTUM, Cav., l.c.* 312, *t.* 167, *var. ?*; *G. INDICUM, Cav., l.c.* 314, *t.* 169; *G. INDICUM and G. ? MICRANTHUM, Willd., in Linn., Sp. Pl., 4th ed.* (1800), III., *pt.* I. 803–4; *G. ? MICRANTHUM, Poir., Supp. Lamk., Encycl. Méth. Bot.*, II., 369 (*describes Cavanilles' plate*); *G. INDICUM, Poir., Dict. des Scien. Nat.* XI., 1818, 38; *G. SIAMENSE, Tussac, Fl. Antl.* (1818), II., 65–77; *G. INDICUM, and ? MICRANTHUM, DC., Prod.* 1824, I., 456; *G. HERBACEUM, Roxb., Fl. Ind.* (1832), III., 184–5, *var. China Cotton*; *G. HERBACEUM, Parl., Sp. Cot.*, 32 (*in part*); *G. NANKING and G. INDICUM, Tod., Rel. Cult. dei Cot.* 147–52, *t.* III., *f.* 1; *G. HERBACEUM, Henderson and Hume, Lahore to Yarkand*, 1873, 314–5; *G. HERBACEUM, var. lana-rufa, Aliotta, Rev. Crit. Gen. Goss.*, 1903, 71.

Nankin cotton.

The 'Chinese cotton' of commerce—'Siam cotton' of most writers—the red-coloured states being the true 'Nankin cotton.'

In no Herbarium examined by me is there any specimen that could for a moment be accepted as matching the flower represented and described by Cavanilles as present in the Persian plant to which he gave the name '*micranthum*.' In all other characters, however,

No. 15. GOSSYPIUM NANKING, *MEYEN.*

(A) Specimen in Sloane Herb. B. M. (Pluk. Vol. 96, f. 62) is very possibly this species; (B) Pluk. Alm. Phyt. t. 229, f. 1, prepared from the specimen A —flower purely imaginary: (C) leaf of the Indian Bani Cotton; (D) Chinese specimen of *G. nanking* proper; (E) specimen grown at Washington from Korean seed.

it is *G. Nanking, Meyen*, and the flower I believe to have been fragmentary or diseased; it is an improbable condition in the genus *Gossypium*.

Description. The present species is a bush with delicately formed and often purple-coloured twigs, leaf-stalks, &c., all parts with shaggy hairs and younger textures with, in addition, a sparse coating of stellate hairs. Leaves imperfectly cordate, half-cut into 3–5 (mostly 3) lobes, the extra pair appearing as if artificially attached, thus making the leaf almost broader than long; lobes ovate-oblong, acute (or even obtuse) to often acuminate, and 3 veins ordinarily with glands below. Bracteoles large, generally half the length of corolla, purplish-coloured, united below, and with 3–4 sharp teeth on the acute apex. Flowers large, but sometimes never fully expanding, yellow with faint purple claws, petals rotating to right, and turning purple with age. Seeds large, densely coated with, most frequently, a rust-coloured fuzz and silky floss that also tends to a reddish colour. **(See Plate No. 15.)**

Cotton of dry soils. The wide range of forms referred to this position are by no means difficult to recognise collectively. They are cultivated on upland dry soils, or during seasons subject to dry weather. The leaves are of a smooth compact texture, very often glabrescent on upper surface, and of pale green colour—characters which once seen can hardly ever be mistaken for either *G. arboreum* on the one side or *G. obtusifolium* on the other. Moreover, the bottom pair of lobes seem always to widen unnecessarily the leaf while they fill up what might be spoken of as the natural cordature of the base. This is the cotton most commonly met with in China, is the type of the series, and may, therefore, be here more fully described in amplification of the diagnostic characters:—

Details. An annual or perennial bush. Has delicate, sparsely branched, round stems, which, on exposed parts (and when fresh), have a purplish tinge below the coating of spreading hairs. The young twigs, leaves, petioles, and peduncles are almost coated with short, adpressed, stellate hairs—a property that gives them, in the herbarium, a soft greenish-grey colour, much like the true *G. herbaceum*. *Leaves* with an extra pair of lobes appearing as if attached to the others, sometimes making the five lobes seem like large crenatures across the upper half, the lobes arching upwards from the often imperfectly cordate base, in a manner which, when once recognised, can scarcely be mistaken; lobes often broad ovate oblong, in Chinese forms usually obtuse, in Indian acuminate and constricted slightly below; sinus rounded, but only rarely furnished with a supplementary tooth; *stipules*, lower, narrow linear acuminate; upper, especially on the peduncles,

broad, unequal, one oblique and toothed, the other narrow linear; *petiole* as long as the blade. *Inflorescence* mostly solitary axillary flowers, which occasionally only are borne on jointed peduncles; *bracteoles* ovate-oblong, deeply cordate auriculate, often fully one-half the length of the corolla. *Calyx* wide and loose, campanulate, with the mouth not at all toothed; interior glands large, triangular, hairy, alternating with and placed within the bracteoles. *Capsule* somewhat angled, ovate-acuminate, 3- or 4-celled. *Seeds* large, irregular, densely coated with rufous velvet, and bearing a good silky floss, which, in all the better examples, is white, but it manifests a strong tendency to become red, or *khaki* coloured.

Habitat.—Cultivated in China, Japan, the Malaya, Siam, Burma, India, the North-west Himalaya, Persia, Central Asia, to the Celebes; less abundantly in Madagascar, Arabia and Africa. No person has recorded the discovery of the wild state of this protean plant, and yet the characteristics detailed are so constant with many of the cottons, within a large part of the areas indicated, that, in dealing with cultivated plants, geographical and agricultural considerations cannot be disregarded. In other words, the separation of the assemblage, from *G. herbaceum*, *G. arboreum*, and *G. obtusifolium*, not only meets a commercial necessity, but coincides with many historic facts of importance.

Never seen wild

Citation of Specimens.—The following are some of the more striking examples of the typical condition seen in Herbaria:—Among the Kew sheets from China are those collected by Dr. S. W. Bushell (1868–71) near Peking (*G. herbaceum* of 'Index Fl. Sin.'); Rev. Ernst Faber, from Yangtze-kiang, n. 580 (1887); Dr. Bretschneider, n. 110, from Peking (*G. herbaceum, var. ?* of 'Index Fl. Sin.') (seeds almost naked and black, a hybrid very possibly); a specimen from the Herb. Mus., Paris (collected by M. l'Abbé Delavay in Yunnan); Dr. A. Henry's (a) Yunnan, n. 11,024; and (b) Formosa, n. 1899 (a poor quality). From Japan there are two Yokohama sheets, on one of which Oldham writes that it is largely cultivated on low, level, sheltered ground; the other from Maximowicz ('Herb. Hort. Bot. Petrop.,' 1862, named *G. herbaceum*, cult.); a third is also from Oldham n. 107, collected in 1862 at Nagasaki. It may, in fact, be observed that the majority of the specimens of Chinese and Japanese cotton, preserved in herbaria, are this plant, though these are mostly named *G. herbaceum*. An excellent example (and manifesting the link of connection that subsists between the Chinese and Indian areas) is Dr. Henderson's n. 1072, collected at Yarkand.

Chinese specimens.

Among the British Museum sheets the following are specially interesting:—Sloane Herb. (Pluk.), vol. 93, f. 185, collected by Cuninghame in (?) China—three specimens on the sheet, viz. (a) *Nanking*, (b) *rubicunda*, and (c) *arboreum*, but named *paretty*, and may also be *var. rubicunda*; (Pluk.), vol. 96, f. 62, = the type of Phyt., t. 299, f. 1 (see **Pl. No. 15 A**), locality ? ; (Camel), vol. 240, f. 39, dated 1700; in the general collection there are: Shanghai, 1852, Fortune, typical form, n. 66; Kinkiang, Forbes, nn. 101, 139.

In the Edinburgh Herbarium there are several interesting specimens, of which mention may be made of the following, in amplification of the above citations:—CHINA, from the Hills, Peking, collected by W. R. Carles in 1882, also from Shanghai, by the same collector, in 1884; from Macao and the islands adjacent, by the Rev. G. H. Vachell, collected in Gardens in 1830; from East Central AFRICA, collected by G. Schweinfurth, n. 779.

In the Cambridge University Herbarium the following, among other specimens, may be mentioned:—CHINA: Macao, coll. Vachell in 1830, n. 285 (ex herb. Lindley); duplicate of ditto, with the following note:—'It is this cotton that the brown Nankeen cloth is made of in China' (ex herb. Henslow); also a sheet determined by Bentham as *G. obtusifolium, Roxb.*, and said to be obtained H.B.C. (= 'Hort. Bot. Calcutensis,' ex herb. Lemann).

Indian specimens.

In the Herbarium of the Royal Botanic Gardens, Sibpur, Calcutta, there are preserved two examples of a cotton which Mr. I. H. Burkill ('Mem. Dept. Agri. in Ind.,' I., No. 4) regards as the types of *G. obtusifolium, Roxb.* Neither bears any date. One was identified by the late S. Kurz (formerly curator of the Herbarium, who died in 1878), and the other, I believe, by the gardener who cut and dried the specimens, both being named *G. obtusifolium*. But these are in no sense Roxburghian specimens and are identically the same, each sheet containing two twigs, one possibly a young shoot, the other an old flowering branch. They moreover match in every detail a specimen in the Kew Herbarium, which has been determined as *G. obtusifolium*, but in that case the record of its origin exists. Seed had been procured from Kabul, and the plant was grown in Calcutta in 1836 (see Pl. No. 17 B). I have little doubt this is the history also of the two Calcutta specimens, and in that case I regard them (like the Kew example) as being *G. Nanking, var. rubicunda*, or closely allied thereto—a plant with red not yellow flowers (cf. Red-flowered Trans-Indus plants, p. 125).

In support of this view I may mention that in the Cambridge Herbarium there is a sheet (also said to be from H.B.C.) which belonged originally to Lemann (who died in 1852), and which Bentham determined as *G. obtusifolium*, which seems to me to have been also very possibly derived from the Kabul stock. Lastly, in the Edinburgh Herbarium there is a specimen of typical *G. Nanking* that bears Roxburgh's name (as if procured from him), and which is named *G. herbaceum*—the name Roxburgh himself gave to a Nankin cotton plant which he obtained direct from China and grew in the Calcutta Gardens. There is thus no doubt that a form of *G. Nanking*, obtained from Kabul, and another from China, were grown in Calcutta, from which specimens were collected and issued with the letters H.B.C. indicative of their origin. It is, therefore, hardly safe to assume that a specimen with these letters, as the sole record of its history, and which had been determined by Kurz perhaps sixty years after Roxburgh's death, could be accepted as a type of *G. obtusifolium, Roxb.* (cf. with *G. Nanking, var. rubicunda*, p. 127, and *G. obtusifolium*, p. 141).

In De Candolle's Herbarium, Geneva, there is a specimen of the typical plant collected by Rein in Japan, n. 23. In the Economic Herbarium, Department of Agriculture, United States, are specimens of plants being experimentally cultivated at Washington:—The *murasaki* cotton, n. 607;

the *kawasaki*, n. 596; and the *aoki*, n. 597—all from Japan; Korean cotton, n. 534; Transcaucasian cotton; and a sample called 'Garo-hill cotton,' n. 600—is certainly not Garo cotton, but much nearer *bani*.

Certain African specimens might be mentioned in this place, though they more correctly belong to one or other of the varieties presently to be indicated than to the typical condition of the species.

Historic records.

Nomenclature.—Trigault (1615) says that cotton grows in great abundance, but is not indigenous to China—in fact, was introduced about 400 years before his time. Dampier ('Voyages,' 1691) speaks of having seen a small cotton plant on an island near Formosa. Du Halde ('Gen. Hist. China,' Engl. Transl., I., 1736, p. 19) describes and figures two cottons as met with in China, one a tree cotton, the other a bushy form. (Cf. Pierre Martial Cibot, 'Mem. Concern. les Chinois,' II., 603.) Barrow ('Travels in China,' 1806, 2nd ed., pp. 556–7, 560) says that the beautiful coloured cotton known by the name of the chief city, Nankin, was exported, the Chinese purchasing in exchange the cheaper white cottons of Bengal and Bombay. It was, he remarks, planted in rows, and grew for three years, thereafter being uprooted and the fields prepared for other crops. Roxburgh, writing almost about the same date, observed that China cotton had recently been introduced into Bengal from China, where it is cultivated, and its wool reckoned 25 per cent. better than that of Surat. It differs from the former sort:—(1) In being much smaller, with but very few, short, weak branches; (2) in being, so far as my experience goes, annual; (3) in having the leaflets of the exterior calyx entire, or nearly so. Then he adds: 'Lamarck's *G. indioum* is no doubt one of these varieties.' Further on, speaking of *G. religiosum*, he makes the observation alluded to in another place, viz.: 'Since writing the foregoing, a small variety of this tawny cotton has been introduced into this garden from the province of Nankeen itself, but unfortunately it promises still less than the first, and the colour and quality of the wool is much the same.' Fortune ('Three Years' Wanderings in China,' 1847, p. 264) explains that the *khaki* or Nankin cotton was a mere sport from the common white cotton of China.

China *versus* India.

Nankin or *khaki* cotton.

I have accepted, in the synonymy given in the paragraph above, *G. Nanking* as at once the most accurate and most satisfactory name for the plant (or assemblage of plants) that it is desired to assign to this position. Meyen was apparently the first botanist who saw

clearly the necessity for separating the Chinese from the more common Indian, African, and Occidental plants.

Plukenet's specimens.

In Plukenet's herbarium (which constitutes a portion of the Sloane collections of the British Museum) there are preserved two or three examples of a plant (vol. 96, f. 62) which I accept with some hesitation as being an extreme manifestation of the present species (see **Plate No. 15 A**), approximating fairly closely to the Indian race called *Bani* (see **15 C**). The former was figured and described ('Alm. Bot. Phyt.' 1696, t. 299, f. 1) (reproduced by me, see **15 B**), but the sample (**A**) obviously used in preparing the illustration (published by Plukenet) does not possess the lowermost leaf (2) nor the flower (1) there given. Plukenet's description was as follows: '*Gossypium frutescens pentaphyllos, ex insula Barbouthensi, segmentis foliorum ad latera rotundioribus, ex quo Cotonum, s. Bombax serici instar candidissima.*' He then adds that no other cotton is preferred to this in whiteness and softness. About the time Plukenet wrote, China cotton had begun to be famous for its silky texture and pure white colour. But before leaving this subject I think it as well to add that one leaf, mounted separately (in Pluk. herb.) shows the central lobe almost cut up into three portions, a peculiarity never witnessed by me in any other specimen, unless the lateral segmentation in some forms of *G. arboreum* (see **Dacca Cotton, Plate No. 12**) be regarded as indicative of that condition.

Linnean publication.

Linnæus made no citation of the above description and plate of Plukenet, in the first and second editions of his 'Species Plantarum,' but in the 'Systema Naturæ' (1767, II., p. 462) he made the mistake, manifest in his herbarium, of confusing *G. hirsutum, Miller*, with the Indian *G. obtusifolium, Roxb.* and the Chinese *G. Nanking, Meyen*; accordingly he cited Plukenet's plant above under *G. hirsutum*. Hence it follows that *G. hirsutum, Linn., Syst. Nat.* has to be spoken of as *non Sp. Pl.*

Volkamer, in 1714 (a century later than Trigault), gave a plate of *G. Nanking* and says the plant had been introduced into China 500 years previously and was supposed to have come from Egypt. Rumphius furnished an admirable description and better drawing of it, but his admission that the two plants figured by him, as also by Rheede, constitute but one species, precludes priority of authorship being assigned to him.

Lamarck's view.

Lamarck took a different view and admittedly gave the name *G. indicum* in order to provide a place for the plant, as figured by

Rumphius, while Cavanilles simply republished Lamarck's description but did not himself recognise the plant, since he gave two additional names and descriptions that can only be accepted as synonyms for it—not separate species. In fact his *G. micranthum* (a Persian plant), while in foliage nearly typical of *G. Nanking*, is figured and described as having such an anomalous flower that it could only have been conceived (as already indicated) from imperfect material. No subsequent writer has mentioned having seen the flowers of a *Gossypium* that could for a moment be accepted as suggestive even of *G. micranthum, Cav.* The bracteoles are also peculiar: they are very large and much united. It is, moreover, curious that Cavanilles should have given his *G. hirsutum* the habitat of America, since it is a matter of history that, in 1758, the French colonists of Louisiana had imported and cultivated the (even by then) much famed (both red and white) Siam cotton (cf. p. 19). From that stock doubtless came the plant described as American, by the great Spanish botanist.

Anomalous Persian cotton.

Siam cotton.

It is significant how persistently writers of the eighteenth century (especially French) allude to Siam cotton. Père Labat ('Nouv. Voy. aux Isles de l'Amér.' 1724, I., pt. 2, p. 127) speaks of it as introduced into Guadeloupe and valued because of its coffee-coloured, soft, silky wool, of which they made stockings that rivalled those of silk. Rohr ('Observ. sur la Cult. du Cot.' 1807, pp. 55–7) describes under the name 'Siam Cotton' (both red and white) a cultivated cotton the original seeds of which he admits having obtained from Guadeloupe. It was, he adds, specially grown in Sainte-Croix by M. le Comte Schimmelmann in 1789. There are, however, two points worthy of special comment: the cotton spoken of by Rohr as valued for stockings was the 'Curaçao' (*G. punctatum, var. jamaica*), not the present species; and although Rohr possessed Cambay cotton (*G. obtusifolium, var. Wightiana*)—'Nun's cotton' as he called it—he did not regard the present plant as in any way related to the 'Nun's cotton.' Crawfurd ('Jour. to Siam,' 1830, II., p. 180) gives particulars of the traffic in cotton (*fai*) from Siam.

Stocking cotton.

Willdenow accepted Lamarck's position as also that of Cavanilles, so that it cannot be upheld that he had a clear notion of the plant for which he retained the name *G. indicum*. Lastly, that name is open to ambiguity, since the plant is more Chinese than Indian, and, although met with in India, is there neither the most important nor the most characteristic species. For these and other such reasons it

seems (when dealing with cultivated plants at all events) permissible to adopt the best name even though it may not have the claim of actual botanical priority.

Eye-marks of Nanking cotton.

The readiest eye-marks, for the assemblage of forms that it is convenient to associate with *G. Nanking, Meyen*, are as follows:— The fact of being mostly perennial plants; the shape of the soft cinereous leaves, which are almost non-cordate and have often three veins bearing glands below; the large, ovate acute, sparsely toothed bracteoles and the yellow flowers with purple spots. Variety *rubicunda* has very similar leaves though smaller as a rule, with only one gland and with obscure adhesive lateral lobes, but its flowers are purple and it might accordingly be regarded as an intermediate form. Still, however, while the differences botanically between the *G. arboreum* and the *G. Nanking* groups are in degree more than anything else, economically *G. Nanking* is, at the present day, doubtless much more valuable than any of the directly *G. arboreum* forms. Todaro reproduces Meyen's original drawing of this plant and gives a second coloured illustration which he says represents a recognisable variety of it, viz. *grandiflora*. The only difference appears, however, to be in the size of the flower, which in *G. Nanking, Meyen*, may not be much longer than the bracteoles, and in *var. grandiflora* is often two or three times longer. With the extensive series of cottons that exist such a distinction must be rejected as unworthy of consideration. The flowers are in fact most frequently longer than the bracteoles, but in the length of the bracteoles there is considerable latitude. Todaro's coloured illustration had better be viewed as representing an annual state with bracteoles a little shorter than is customary, and Meyen's picture may fairly well be regarded as showing the normal condition of the corolla.

Size of flower.

The bracteoles relatively to the corolla are shorter in the average Indian examples than in the Chinese, so that in this respect they resemble Todaro's picture more than that of Meyen. On the other hand, some of the *G. Nanking* series of cottons display characters of far greater interest than the mere length of the corolla (which Todaro lays stress on), and they might in fact be broken up into varieties or distinctive races. Thus for example Dr. Bretschneider's specimen (already mentioned) has the seeds black—that is to say, almost devoid of an under velvet—a character which brings to mind the naked or black-seeded so-called indigenous cottons of South India (see p. 153), but it is highly probable that both these may have to be regarded

Recessive forms.

as indicating hybridisation with *G. purpurascens*, if not even with *G. barbadense* or *G. brasiliense*.

Colour of flower.

Some of the Indian examples of this species have purple flowers, others yellow with purple blotches, and in still others the flowers are pale yellow with a purple tinge on the extremities of the petals. A range of variability such as that can best be accounted for on the assumption that the assemblage embraces many cultivated races, each owing very possibly its peculiarities largely to hybridisation. The floss is often at all events of a very superior kind. Dr. Henderson, for example, says of the plant seen by him in Yarkand that it bears an enormous quantity of pods, with a much longer and softer fibre than the Indian cotton. But the Central Asiatic races, as already observed, may be viewed as constituting the link of connection between the Chinese and Indian forms.

Cultivation

Special Forms.—It would be rash to affirm (in the present state of knowledge) that the special cultivated states to which *G. Nanking* may be referred constitute definite varieties that can readily be separated from each other. The point of importance is that within certain fairly well-defined areas there are commercially and agriculturally distinctive cottons that would appear to be states or races of *G. Nanking*. The *first* of these geographical forms is the most important cotton of the warm temperate tracts of Northern India (including some portions of the plains of the Panjab), but more especially the North-West Himalaya. Though met with in other regions (*e.g.* the mountains of South India, Upper Egypt, Persia, Central Asia, &c.) it is hardly anywhere so abundant as in the Himalaya, and the varietal name *himalayana* accordingly seems appropriate. The second, already discussed, having purple flowers, is appropriately designated *rubicunda*. The third form is of importance mainly in South India and Burma, and its most general vernacular name—*nadam*—may, therefore, with advantage be used for its botanical designation. The fourth may be spoken of as a group of cottons, mostly annuals, and which in point of shape of leaf can hardly be separated from many of the *nadam* cottons. The best and most general name for these is *bani*. They are met with, so far as India is concerned, in the Deccan, the Central Provinces, Rajputana, Kathiawar, the United Provinces and Bengal, but they occur also in Madagascar and Abyssinia. The fifth special form of *G. Nanking* is characteristic of certain parts of Western India, and

Geographical forms.

is there called *roji*. That name may, therefore, be usefully employed to denote the plant in question, but examples of it appear to be quite as numerous in Africa as in India, though it would seem to be always a more local plant than either *nadam* or *bani*. Origin of Chinese stock.

Lastly, I have proposed the name *soudanensis* for a special form that seems peculiar to Africa and Egypt, and which appears, moreover, to be a very ancient type, which in some respects supports the oft-repeated opinion of China having obtained its original supply of this cotton from Egypt. It is a perennial bush much like the *roji*, but quite glabrous, and the leaves more deeply segmented (approximating to *G. arboreum*); the flowers are yellow with purple spots, and the bracteoles broad ovate, much united below and deeply laciniated around the margin. Soudan cotton.

As exemplifying still other special forms I may mention that I have had the pleasure to receive an interesting series of botanical specimens of the cottons at present experimentally grown in the Testing Garden, Washington, under the supervision of Mr. Lyster H. Dewey. Among these are the following examples of this species:

From Japan.—1. *Murasaki* Cotton, a plant with long, spreading white hairs on the shoots, petioles, and peduncles, and with exceptionally broad leaves, 3- to 5- lobed, having very often teeth in the lateral sinuses, leaf-stalks long rigid, glands below very inconspicuous and usually only one. Bracteoles purple-coloured, large, oblong, with two or three large irregular teeth. Flowers axillary, borne on short peduncles one-third length of petiole, large, yellow with purple claws, and limbs turning purple with age. Fruit globose, completely enclosed within the accrescent bracteoles. Japanese cotton.

2. *Kawasaki Cotton.*—This differs from the preceding in the stems, shoots, petioles, and peduncles being very minutely pilose. Flowers extra-axillary, borne on peduncles equalling the petioles. Bracteoles very large, ovate cordate, coarsely (5–9) toothed, and flowers yellow, apparently not turning purple.

3. *Aoki Cotton.*—Might be described as an intermediate form to the two previous. It has the short pubescence of *kawasaki* and the short peduncles of the *murasaki*.

From Korea.—4. The Korean cotton is much like a large-leaved *kawasaki*. The stems, &c., are strongly furrowed and angled, the leaf-stalks have a woolly texture, but the plant is otherwise almost glabrous, and glands obscure. Flowers extra-axillary, yellow with strong purple claws. Bracteoles ovate oblong, acute, 3–5-toothed (see **Plate No. 15 E**). Korean cotton.

From Transcaucasia.—5. The plant contributed under this heading has reddish-brown glabrous stems, twigs, petioles, &c., the inflorescence pronounced lateral shoots bearing three to five leaves and flowers, the first internode being 3–6 inches long, the whole plant glabrous, and the leaves with five deltoid tapering lobes that strongly recall the variety *himalayana* (**see Plate No. 16**). It is thus very possibly a hybrid cotton, an opinion that would seem confirmed by the examination of its pollen-grains.

Supposed Garo cotton.

From India.—6. A sample said to be Garo Hill cotton. There must have been some mistake, however, in the seed supplied, as the plant in question is *G. Nanking, Meyen*, var. *Bani* (cf. p. 111, remarks under *assamica*). In shape of leaf this has come up closer, perhaps, to the true Chinese form than is customary in India—a consequence, possibly, of the superior cultivation to which it has been subjected; but it has nevertheless preserved in the altered environment all the characteristics of the plant as named and described by me. The whole plant (stems, leaves, &c.) is softly pilose-tomentose, and the bracteoles ovate acute, 3-toothed. It manifests, in other words, no trace of its supposed Garo origin, hence, if the seed supplied was drawn from the so-called acclimatised stock of Nagpur, it has reverted to the elder parent—the *bani* of Berar.

An extensive acquaintance with the cultivated cottons of China, Japan, Siam, the Malaya, &c., as also of Africa, will in the future doubtless suggest other varietal or racial groups in amplification of the more or less Indian series that may be here detailed, but nothing, I confidently believe, will be discovered to upset the main contention that they can be assorted under *G. Nanking, Meyen.*

16. Var. himalayana, *Watt.*

The whole plant often hairy; leaves large, broad, the lobes triangular acuminate, and the base hardly cordate; flowers large, yellow (**see Plate No. 16**).

Description.

A herbaceous annual or perennial, cultivated in warm temperate tracts. In the Indian form the leaves are large, lobes triangular acuminate (f. 1), the whole plant frequently very hairy—a departure from the type that possibly denotes hybridisation with *G. obtusifolium*. In fact, at first sight this might be mistaken for one of the forms of *G. obtusifolium*. Indeed, nearly all the specimens in Herbaria which I have placed in this position were found by me bearing the name *G. herbaceum, Linn.*, or *G. Wightianum, Tod.* They are, however, as a rule much less hairy than *G. obtusifolium*, and in texture and tomentum are nearer the true *G. herbaceum, Linn.*,

M. Smith delt, J. N. Fitch lith. West, Newman imp.

No. 16. GOSSYPIUM NANKING, *MEYEN*, VAR. HIMALAYANA, *WATT*.

1, Flowering branch; 2, bud hid within the large loose calyx with its conspicuous glands; 3, fruit elongated, beaked; 4, fuzzy seed with fairly long silky floss.

but the shape of the leaves with long tapering lobes, especially when viewed in the light of the other characters detailed under *G. Nanking*, leaves no room for doubt that this plant should be looked upon as a somewhat remarkable Indian representative of the large and distinct series of cultivated plants derived from *G. Nanking*, but which through hybridisation now almost stand between *G. herbaceum* and *G. arboreum*. Moreover, the twigs, leaf-stalks, and peduncles are, for the size of the plant, slender, round, and purple-coloured, and in mature structures almost glabrous. So also in rare instances the flowers are purple (as, for example, in Falconer's Kashmir specimen, n. 287), and it then becomes difficult to separate this plant from *var. rubicunda*. In the Himalayan form the capsule is usually considerably elongated and very acuminate (f. 3), and the seeds coated with greyish-brown velvet (f. 4), below the somewhat silky floss.

Himalaya and Central Asia.

Habitat.—This is one of the chief forms grown along the Himalaya and on some of the lower hills of India proper, where it is generally called *bagar* or *watni* cotton. It is to a large extent the cotton plant of Central Asia (being close to the Transcaucasian and Korean plants above mentioned), and was the form very possibly seen by Marco Polo in Yarkand, and long subsequently by Henderson. Occasionally it is replaced as a field crop on the plains of Northern and Eastern India by *G. arboreum, var. sanguinea* or by the next, variety *rubicunda*, and in Gujarat, the Deccan, and South India by the *roji* and *nadam* cottons. It seems probable that the Chinese and Japanese forms yield superior staples to any of the Indian representatives; on this account, and because the true *G. Nanking* has repeatedly been introduced into India (see the passage from Roxburgh), it seems desirable to separate the Indian from the Chinese plant.

Specimens.

Red-flowered race.

Citation of Specimens.—The following specimens may be mentioned as typical and as manifesting the distribution of this plant:—India: T. Thomson, Kashmir, cultivated at 5,000 feet in altitude, also another plant in the Herb. Ind. Or. Hook., f. and T. Thomson, from the Nilghiri hills (Mad. No. 18); Falconer, Kashmir, No. 287, has small red flowers, and thus approximates to *var. rubicunda* (cf. p. 117); Aitchison, n. 462, collected at Thal, west of Kuram (alt. 4,000 feet), and Aitchison, n. 46, Jhelum; Falconer, Panjab, n. 288; Thomson, Lahore (1846); and herb. Rottler named '*G. mauritianum*.' But as admirable examples of the ordinary Himalayan state of this plant, I may quote Duthie n. 19,261 from Hazara; Lace n. 1836 from Chamba, as also my own nn. 9776, 7990, 10,210, and 13,449, collected from fields north of Simla at altitudes of 5,000 feet, and Mr. Gammie's Kashmir plants, as also the Yarkand Expedition specimens procured by Henderson (1870). On the other hand, Thomson's sample from the banks of the Chenab (1846) comes very close to the *nadam* cottons of Madras, and Griffith's Bhutan plant seems a hybrid approaching var. *neglecta*. It would appear highly probable that the Persian cultivated plant mentioned by

recent travellers in that country is closely akin to that described and figured by Cavanilles (*l.c.*). For example, Lord Curzon ('Persia and the Persian Question,' II., 1892, pp. 496–7) speaks of cotton growing with facility at an elevation of 5,000 feet. This is very possibly the present plant, and it was most likely the species seen by Marco Polo in Persia during the thirteenth century. British Museum specimens :—Herb. Schlagintweit Cat. n. 4236, Kashmir, 1856; Herb. Hook. f. & T. T., Nilghiri and Kurg Hills, a duplicate of which may be seen in M. de Candolle's Herbarium, Geneva. In Edinburgh Herbarium, Schlagintweit's n. 12,445, collected at Marri (5,000 feet alt.), Nov. 1856.

17. Var. rubicunda, *Watt:* *G. RUBICUNDUM, Roxb., MS. name and drawing.* (See Plate No. 17, types, also Plate No. 18, Roxburgh's MS. coloured sketch.)

Red-flowered Nanking.

So much has been said regarding red-flowered field cottons under *G. arboreum, var. sanguinea* that very little remains to be said about those that have to be provided for under *G. Nanking*. The descriptions of travellers, and often of botanists also, are so general that it is rarely possible to separately distinguish the two kinds of red-flowered cottons referred to by them. There are, however, certain specimens that so fully support the present plant that it seems desirable to enforce its recognition as a practical, if it be not a botanical, fact. The plant in question may be briefly described as follows :—

Description.

A herbaceous, red-flowered condition, with, as a rule, smaller leaves than in either *G. Nanking* or *G. arboreum*. In the young state, these are densely covered with stellate hairs, and the twigs, petioles and peduncles with even spreading hairs. *Leaves* half cut into 3-5 lobes, and only slightly cordate, the lobes spreading, somewhat triangular to oblong, acute, constricted below into the rounded open sinuses. *Bracteoles* large, ovate cordate, sub-entire. *Calyx* truncate, *i.e.* not toothed. *Corolla* deep purple, small, but wide and gaping, with pronounced convolvulate hairy folds. *Capsule* small sub-globose or ovate acute. *Seeds* with brown velvet and easily separable long, fine, and pure white silky floss.

India.

Habitat.—This occurs occasionally over the hotter parts of India, and would appear to be almost confined to that country, though it has been collected in Ceylon and China.

Citation of Specimens.—In the Kew Herbarium there is a sheet of this plant (ex herb. Forsyth) with a label bearing Roxburgh's name attached to it (see Plate No. 17 C), which matches his MS. drawing (see Plate No. 18), except that the drawing seems to show too many of the leaves 5- instead of 3-lobed. Another specimen collected by Griffith at Serampore, near Calcutta, is a good example. G. Thomson's specimen from Palaveram, Madras, collected in July 1845, is a form in which the

No. 17. GOSSYPIUM NANKING, *MEYEN.*, VAR. RUBICUNDA, *WATT.*

(A) Specimen in Linn. Herb. Lond. named by Linnæus himself as '2 *præstantissimum*'; (B) Griffith's Kabul plant in Kew; (C) a Roxburghian specimen in Kew, possibly the type.

No. 18. GOSSYPIUM NANKING, *MEYEN* VAR. RUBICUNDA, *WATT.*

Photographic reproduction of the Kew Gardens copy of Roxburgh's original MS. illustration named "1424 (1496) Gossypium Rubicundum, Roxb." corrected into "arboreum"; preserved in the Herbarium Library, Royal Botanic Gardens, Calcutta.

leaves are densely coated permanently with stellate hairs. Rottler's specimen from Mysore is doubtless also the same plant, but with possibly a strain of *G. arboreum*. The lobes of the leaves are narrower, and the sinus more acute. Griffith's Kabul specimen (see Plate No. 17 B), raised in Calcutta in 1836, from seed supplied by Captain Wade, is named *G. obtusifolium*, *Roxb.*, and Maxwell T. Masters accepted that name for it in his article in the 'Fl. Br. Ind.,' but it seems to me a good example of *var. rubicunda* (cf. remarks under *G. Nanking*, p. 117; the Kashmir and Afghan plants mentioned under *var. himalayana*, p. 125; also *G. obtusifolium*, p. 141). In the Saharanpur Herbarium there is an example procured by Duthie's collector (n. 21, 603,) from Gorakhpur, that bears the date April 1898. Afghan cotton.

In the British Museum Herbarium the following specimens may be mentioned as being this variety: China: Henry Bradley (1779) (leaves often 5-lobed); Cape of Good Hope: collected by Oldenburg (growing in gardens in 1772). In the Edinburgh Herbarium, two specimens: one collected by Brodie in Ceylon, n. 80; the other marked 'Ind. Or.,' which matches exactly the Roxburghian plant reproduced on Plate No. 17 C. In De Candolle's Herbarium, Geneva, there is a specimen of Wight's (n. 178) that seems to me to be this variety; also another collected by M. Gaudichaud in 1830.

Nomenclature.—As already repeatedly urged, a red-flowered field-cotton would appear to have been one of the prized crops of India a century or so ago. Hove, on the Western side, and Hamilton, on the Eastern, both spoke highly of these cottons (cf. *G. arboreum var. sanguinea*, pp. 93–5). To what extent the present form may have fallen under that category is a little difficult to discover. In the Linnean Herbarium, London, however, there is a specimen of what I think there can be no doubt is the present variety. It is named in Linnæus's own handwriting, '2 *præstantissimum*,' but of that specimen, or of that name, Linnæus made no mention in any of his works. What led him to so designate it, or whence he obtained his specimen, is never likely to be now discovered. The name 'the very excellent' is, however, significant of the contention here put forth—namely, that there were cottons with red flowers that were highly spoken of some years ago. I have photographically reproduced (**Plate No. 17 A**) the Linnæan specimen, as also what may be accepted as the Roxburghian type (**C**), and in addition a specimen from Griffith's herbarium (**B**), grown in Calcutta; these three specimens may, I venture to think, be accepted as the types of the plant in question. But let it be here clearly observed Roxburgh had no hesitation in figuring and describing his *G. rubicundum* as perfectly distinct from his *G. obtusifolium*, though most subsequent botanists confused the two and very frequently called both by the latter name. Linnean specimen. Roxburgh's type.

Further evolution.

It is significant, also, that all the best examples of this plant seen by me, appear to have been procured in India, and the majority from South India. It might be described as, and probably is, a hybrid from *G. arboreum* with *G. Nanking*. But it seems to have been supplanted and its place taken in Madras and the S. Deccan to a very large extent, and possibly at a comparatively recent date, by the yellow-flowered *nadam* and *bani* cottons—which may be viewed as still further hybrids, bringing the stock very much nearer to the typical condition of *G. Nanking*. If this assumption be supported by future investigation, it would account for the yellow flowers and spreading hairs of these South Indian cottons—which otherwise might, from the texture and shape of their leaves, the shape of the bracteoles, the character of the seed and wool, &c., be treated as forms of *G. arboreum, Linn.*, and indeed they have frequently been so treated. [*Cf. Perennial Cottons in 'Planter,' Aug.* 29, 1896; *Bomb. Chamb. Comm. Rept.* 1900, *p.* 126; *Ann. Rept. Director Agri. Bomb.* 1900–1901, 24.]

18. Var. Nadam, ***Watt:*** *Capas, Rumphius, Herb. Amb.*, IV. *pp.* 33–37, *t.* 12; *Middleton, The Agric. Ledg. n.* 89 *of* 1895, *p.* 8; *G. INDICUM, Gammie, Indian Cottons* (1905), *v.* 6, *pl.* IX. (*in part*); *Dict. Econ. Prod. Ind.* IV., 101–2.

Coconada.

In trade the cotton of this assemblage is often designated 'Coconada,' and besides *nadam* there are several other vernacular names that denote the series, such as *yerra* (red), also *paira, burada*, &c., and in Burma *wa-gale*. They are perennial bushy plants with dark-green foliage and deep red-coloured stems that recall in many respects *var. rubicunda*.

Description.

Leaves thick, leathery with age, becoming almost glabrous, and very conspicuously gland-dotted, 3- to 5-lobed, the lobes usually very broad, almost triangularly ovate, tapering, the three prominent ribs with glands below. Flowers bright yellow, with purple spots on the claws, pinkish-coloured in bud, as also on passing maturity. Bracteoles relatively thick, sparsely toothed.

South Indian cottons.

Habitat.—The Deccan and South India, Burma, and possibly distributed to Arabia and Africa—never recorded except under cultivation. This special form might be spoken of as fringing the natural habitat of *G. Nanking* and blending into the Indian cottons—hence its occurrence in Bhutan, Manipur, Assam, Burma, South India and the Deccan. It is, in other words, the tropical borderland

manifestation, as *var. himalayana* might be regarded as the corresponding temperate form. This doubtless is the plant alluded to by Symes ('Emb. to Ava.,' 1795, II. 83), which was spun and woven by the women of Burma into the fabrics used by themselves and their husbands.

Specimens.

Citation of Specimens.—In Herbaria the following may be found:— Buchanan-Hamilton's sample from Rangoon; Wight, Herb. Pen. In. Or. n. 214; Griffith, Ava n. 51 (cf. Private Journals, p. 147); Tinnevelly cotton from Central Museum, Madras; Dr. Charles Richie, Deccan collections nn. 59 (said to be wild cotton) and 59 (2) Ahmedpur (both in Edinburgh Herb.); Reporter Econ. Prod. Ind. n. 22,007 (*yerra patti*); n. 21,886 Coconada; n. 21,884 *nadam*; n. 23,797 and n. 22,302 *wa-gale* from dry central Burma; also ? n. 22,932 *wa-gyi*; Watt, Manipur cotton n. 5824; specimen in Herb. Royal Botanic Gardens, Calcutta, collected by Masters in 'Mikur hills' in February 1845. There are also in the Calcutta Herbarium several additional species of interest, such as Rottler's n. 330 and Gamble's n. 16,097. Hove (Br. Mus. Herb.) 'Yellow Cotton from Joynegare' (Junagadh), is a most remarkable plant, leaves very small, very like *G. arboreum*, but densely tomentose, hence incorrectly named *G. tomentosum*; wool reddish-coloured. Griffith's Ava specimen collected in 1834 is exceptionally hairy, at least the sample of it in the Cambridge Herbarium is so, though I believe it to be this plant.

Nomenclature.—The assemblage it is desired to assign to this position has been admirably represented by Rumphius ('Herb. Amb.' t. 12). He tells us that his plant was a perennial bush that differed from the cotton of Hindustan, Asia, and the islands of the Mediterranean. It is, however, just possible that he had never actually seen the Indian cottons, even although he adds that the small herbaceous form is common in Bengal, especially on the Coromandel coast. His plant is undoubtedly different from the most abundant herbaceous cotton of India to-day, but is typical of the Deccan and South Indian group of perennial cottons. The plate figured by Rumphius is thus of the greatest historic value, since it establishes the fact that these perennial cottons have been known in the East for several centuries.

Nadam *versus* Uppam cottons.

The plants of this series often blend, however, so gradually into those discussed under *G. obtusifolium* (the *uppam* cottons of South India) that it becomes a matter of great difficulty to separate them, especially when represented, as is often the case in herbaria, by fragmentary specimens. The *nadam* cottons are, as a rule, far less hairy (except on the petioles and veins), the leaves are thicker and have very frequently three glands, the segments longer, broader, more tapered, the sinuses larger and wider, and the bracteoles smaller and less distinctly toothed than are those of the *uppam* and

South Indian cottons.

other cottons derived from *G. obtusifolium*. The writer has on his table at the present moment an extensive series of forms, all of which he regards as belonging to this position. Thus, for example, on the extreme left hand he has placed the *roji* cotton of Gujarat as the form of yellow-flowered perennial cotton which, in foliage and other structural peculiarities, approaches nearest to *G. arboreum* of any of the *G. Nanking* group. Next the *yerra patti* or *errapathi chettu* of Kistna and Karnool (nn. 131 and b. 1 and 4)—a plant which does not appear to attain to a greater stature than three feet, and which in many respects resembles *var. sanguinea* but with yellow flowers and triglandular midribs, thus coming close to the *bani* cottons of the Deccan. *Errapathi chettu* is a profusely flowering plant with the leaves much smaller than in ordinary *nadam*, and in which the tertiary branches, instead of producing one or at most two flowers (as in *G. arboreum*), are elongated and bear three to six flowers, so that the plant becomes pyramidal. Flowers are yellow but with purplish tinge, and the cotton large, coarse, and dirty white. Next, the *nadam parthi chedi* of Coimbatore (n. c. 22) and also other examples of the same from Coimbatore (nn. c. 4 and 19). All these are found on sandy or red soils, but those that may now be given are said to be grown on black soils and approach very closely to the condition met with in *G. obtusifolium*. They are *karung kanni parthi chedi* of Tinnevelly (nn. d. 1, 8, 11 and 14); and the *villa kanni parthi chedi* of that district (n. d. 4). Both these are said to be grown as mixed crops, but to attain a height of only 2–3 feet. The remaining forms of *nadam*, that might be mentioned, partake far more of the *uppam* or *rekkam* characteristics, and indeed appear to have been collected from fields of that plant, and are apparently sports or natural hybrids. So also many of the forms of *errapathi chettu* (above mentioned) come remarkably close to the *roji*.

I adopt the name *nadam* (or *yerra*) because it is that ascribed by the Natives of India to one of the most extensively cultivated representatives of the present series of cottons—the *nadam* (or *paira* or *burada*) cottons of South India. Professor Middleton speaks of it as the *roji* of Madras, but he might also have added 'or the *bani* of Central and Northern India.' In fact the separation of the varieties or races of *G. Nanking* is exceedingly difficult, and the names I have suggested should perhaps be accepted as indicating geographical and agricultural rather than botanical forms. There is, however, a

considerable range within even the *nadams*. Generally speaking they are the inferior cottons of the Madras Presidency; have often flowers pink in bud and turning reddish purple with age (hence called *yerra* cottons); they are sown either during the north-east monsoon (September to November) or during the south-west monsoons (from April to June), and occupy the land from three to five or more years. They begin to bear in about nine months after sowing, and yield two harvests in their second year, viz. the one in September and the other in January. They are mostly grown on red sandy or stony soils, very rarely on black soils. They are for the most part perennials and as such attain a height of six or eight feet; they are accordingly largely cultivated as mixed crops, being grown in rows through the fields or as hedges to protect other crops.

Inferior cottons of Madras.

19. Var. Bani, ***Watt:*** *G. HERBACEUM, Linn., var.—Berar Cotton—Roxb., Fl. Ind.* III. (1832) 185; *Middleton, l.c. pl.* III., *G. HERBACEUM, VAR. JETHI, Gammie, l.c.* 4 *pl.* IV.; *Dict. Econ. Prod. l.c.* 88, 129.

The description of the shape of the leaves and colour of the flowers of this plant is almost precisely that given for *nadam*, except that the leaves in the finest grades of *bani* are much larger, thinner in texture, more undulated in outline, and much more hairy. The bracteoles are usually very large, purple, entire or with a few long pointed teeth. It is a cold weather and early maturity cotton, and yields the fibre in five to six months. Advantage is taken of this fact to grow it during favourable months without irrigation. Accordingly cultivation has been recommended for regions where at present it is not grown, advantage being taken of artificial irrigation, as for example, in the Jhelum and Chenab canal systems.

Description.

Habitat.—In India it occurs in Berar, the Central Provinces, Kathiawar, Sind, Southern Panjab, the United Provinces, Behar and the drier tracts of Bengal. Is essentially the best cotton met with on all the dry soils that have to be classed as second best in cotton production. It is also found in Africa (Abyssinia), Madagascar, and Gorontalo, N. Celebes.

Berar &c.

Citation of Specimens.—In Kew Herbarium:—Royle's sample from N.W. Ind.; Mr. Riedel's specimen, presented by Dr. Meyer in June 1875; Banda, Mrs. A. S. Bell n. 371 ex Herb. Calc.; an extensive series (of date 1891) from Saharanpur herbarium. In Herb. R.E.P. (Cult. Poona Exp. Farm) *deshi* n. 21,874, Sultanpur n. 21,878, *jethi* n. 21,876, *mathio*, n. 21,889, *moto*

Specimens.

mathio n. 21,891 and *tiffinia* n. 22,034 and Hinganghat *bani* n. 1799. In Br. Mus. Herb.:—Wight, Cat. n. 178 (in Camb. n. 176). In Shuttleworth Herb. (said to be Wall. Cat. 1881a): a fine example by Hildebrandt, n. 1208, from Dare Salem, February 1874. Hildebrandt, n. 692, from Abyssinia, collected September 1872, seems a form of this plant, but mistaken by some writers for *Cienfuegosia pentaphylla, Schum.*; Fortune, collected in China (Shanghai) 1845 n. 116a—seen in B.M. and Cambridge Herbaria.

In De Candolle's Herbarium, Geneva, there is a specimen collected in 1853 by Zollinger in Java (n. 153) that I am disposed to place under the present variety.

Hinganghats and Oomras.

Nomenclature.—This affords the finest and most silky qualities of the cottons known in trade as the *Oomras* (Amraoti), the Hinganghats, the Nagpurs and Berars. Under each of these there are usually two grades, viz. the *bani* and the *jari*. The former grows on the higher and drier soils, especially of the southern districts, and gives a fine silky floss, but low yield. The latter is raised on the lower black soils of the northern districts and gives an inferior staple of a woolly character, but does so very profusely. *Jari* seems originally to have been simply a lower quality of *bani*, and produced possibly by crossing it with *var. neglecta*; nowadays it is pure *neglecta*. To the circumstance of *bani* being one of the races of Chinese cotton is due its white silky staple. By writers hitherto *bani* has been classed as one of the forms of *G. herbaceum* or of *var. Wightiana*, an opinion which arose very probably in consequence of its being usually grown as an annual crop. It bears numerous distinctive names and manifests a considerable range in quality of staple. It mingles with the *nadam* cotton of the south and east, with the *roji* of the west and with the Himalayan cottons of the north. It is known in Behar as *jethi* or *desi* (*deshila*); in Bengal proper it is *bhoglla*; in Berar it has numerous synonyms, such as *tidki*, *judi*; in Southern Kathiawar it seems also to be known by the names of *mathio*, *tiffinia*, *gangri* &c., though the first mentioned is also given to a form of *G. obtusifolium var. Wightiana* (*lalio*).

Their origin.

The *nadam* and *bani* cottons, though closely allied botanically, stand very nearly at the opposite poles economically. The former are mostly perennials that afford the lowest grade staple of the country where they are grown; the latter are often remarkably short-lived annuals that produce as a rule the best cottons in the regions where they are cultivated. Such differences may be a consequence of agricultural methods and environment, or they may denote the presence in the *bani* cottons of a strain of hybridisation not indicated

by the structural peculiarities recognised as diagnostic of *G. Nanking*, indeed some of the *bani* cottons are most probably *G. Nanking* hybridised with *G. obtusifolium*. Within recent years the *bani* cottons of Berar and the Central Provinces have fallen into comparative neglect, through the demand for cheap short staples. Cottons that apparently had been originated on still less productive soils than those of the *bani*-growing tracts have been carried to the *bani* country, and, their substitution proving remunerative, the superior crops have become unpopular if they have not been entirely ejected. The demand for cheap short staples, it is now recognised, has thus caused a destructive substitution of inferior for superior cottons which it may take years to remedy.

Bani the best breeding-stock.

Professor Middleton (*l.c.* p. 24) very truly observes: 'What we want in India at present is a cotton that suits clay soils, ripens within six months, and produces a good staple and a fair yield. The *bani* of the Central Provinces at one time supplied most of these requirements, but it is not hardy and the outturn is small, so that it is dying out and very inferior plants are taking its place. Every effort should be made to preserve this stock, for if it can be got to cross with the *deshi* of Broach or even the *wagria* of Kathiawar, I think there would be every chance of securing a cotton that, with judicious breeding and selection, might be of the greatest value to the country.'

Origin of the Varadi.

It is an instructive circumstance that Major Trevor Clarke seems to have held the very same opinion, for he uniformly urged that the *bani* was one of the best of Indian stocks to be used in breeding experiments. He seems to have aimed at improving the quality of the copious yielding Garo hill cotton by crossing it with *bani*, and most unfortunately to these experiments is due apparently the appearance of the *varadi* cottons of India, the triumph of high yield in low grade. It does not, however, follow that that result need be the invariable consequence of all future endeavours with *bani* cotton. (See p. 336.)

High yield in low grade.

Speaking of the cotton area of India, Professor Middleton observes there is a 'third class of cotton soil which is too sandy or has too small a rainfall to ripen any of the finer races; on this land the perennial cottons of Gujarat and Madras and the bulk of the "Bengals" of commerce are raised. From the commercial point of view nothing could be worse than the fibre produced by this third-class soil, and there is a very large field for improvement.' 'For

inferior land it is essential that we have a quick-ripening (4–6 months) cotton, and for the rest the finer, whiter, and more abundant the fibre the better.'

Hybrids.

Professor G. A. Gammie's observation ('Note' &c. 1903, p. 15), that by crossing *varadi* with American (Dharwar) cotton (*G. hirsutum*) he had produced a plant closely resembling *bani*, is interesting. But if his cross-bred cotton (shown *l.c.* in plate II.) fairly represents his (V. × D.) cross, it could not in my opinion be placed as a characteristic example of the *bani* cottons. This will, I think, be apparent by comparing plate IX., ff. 1 & 2 (said at p. 6 to represent normal *bani*) with the cross-bred cotton plate II. It is, however, impossible to form definite conclusions regarding artificially produced crosses without having studied the living plants in question. I have therefore accepted Professor Gammie's opinion that the hybrid resembled *bani*, and in another passage have offered an explanation of that circumstance (see pp. 111–2).

Hybrids said to be impossible.

Several writers have, however, affirmed that the Chinese plant, *G. Nanking*, has never been successfully crossed with the Indian *G. obtusifolium*. (See Middleton's opinion below under *roji*.) Major Trevor Clarke, as a matter of fact, actually did cross *bani* with Garo hill cotton. Moreover it is difficult to understand the reason for thinking a cross impossible, and indeed I am disposed to believe that many such crosses actually exist. (Cf. pp. 111, 113, 336.)

But before passing to consider the next variety I may add that there is a sheet in the Kew Herbarium from British Guiana, collected by Jenman (n. 5149), which is said to have been spontaneous. The plant was probably introduced from India and, being not appreciated, had been allowed to run wild, just as many American cottons exist under similar conditions in India. It has, however, preserved its distinctive characteristics in its ferine state, a fact with many others that confirms belief in the acceptance of *bani* as a distinct variety.

20. Var. Roji, ***Watt:*** *G. VAUPELLII, Graham, Cat. Pl. Bomb.* (1839), *p.* 15; *Prof. T. H. Middleton, The Agri. Ledg.*, 1895, *n.* 8, *p.* 5; *Dict. Econ. Prod. Ind.* IV., 63.

A perennial, bushy, yellow-flowered, cultivated cotton; young parts green-coloured, stellately hairy, the mature structures subglabrous; leaves thick, leathery, rigid, usually with three glands below and often with an extra pair of lobes within the lateral sinuses.

Professor Middleton (*l.c.*) published an admirable account of this plant, from which the following description may be abstracted:—A tall, much-branched shrub, often climbing in hedges 6–8 feet, with straight ascending branches. Young parts covered with stellate hairs which fall off, leaving the mature structures glabrous or with a few long simple shaggy hairs, thus causing the gland-dots to become very conspicuous. Stems and branches cinereous or with a brown tinge on the exposed parts. *Leaves* thick, leathery, dark green, shining, margins straight, cordate, mostly five-lobed and half segmented, lobes ovate acute or acuminate, somewhat constricted at the base; petioles nearly as long as the blade and thickened at the base; *stipules* small, those on the peduncles unequal. *Inflorescence*, secondary or tertiary buds that bear at most three flowers; *bracteoles* toothed or entire, deeply cordate, nearly half the length of corolla. *Flowers* large, pale yellow with purple centre, turning pink with age; calyx truncate or crenulate, three large glands at the base and within the bracteoles. *Fruit* trigonous, ovate acuminate, opening freely when ripe. Seeds 5–7 in each cell, with greenish-grey fuzz and firmly adhering white wool; staple short and harsh. *Seeds* less valuable for feeding purposes because of the greater percentage of fuzz than on other cottons. Description.

Habitat.—India (Gujarat, especially in Baroda and Khaira), Africa, Arabia, and Madagascar. Gujarat.

Citation of Specimens.—East Africa: collected by Sir John Kirk in Zambesia, 1858 (the *Tonje kaja* cotton). Central Africa: Schweinfurth (January, 1869), n. 941, from White Nile (is possibly *var. Nadam* rather than *Roji*), n. 779, from Khartoum; Arabia. collected by W. Lunt during Mr. J. Th. Bent's Hadramaut Expedition, 1893, n. 131 (is possibly nearer to *var. Nadam* than *Roji*). Madagascar: collected by Albro Grevi, n. 128; Abyssinia: collected by Schimper, n. 691, 1839 (specimens in Geneva and Cambridge Herbaria). In Herb. R.E.P. Calcutta numerous specimens from Baroda, Gujarat.

Nomenclature.—One of the earliest and most interesting allusions to, what would appear to be, this cultivated cotton, is that given by Marco Polo. Speaking of Gujarat in the 13th century, he observes that there is a great deal of cotton, the plants growing to trees fully six paces high (? 30 feet) and attaining an age of twenty years. But he adds, when the trees are so old as that, the cotton is not good to spin, but only to quilt or stuff beds. Up to the age of twelve years the trees give good spinning cotton. This is almost precisely the statement furnished by Serapion four hundred years previously regarding (?) Arabia. (Cf. with *G. arboreum*, p. 85.) Gujarat perennial cotton.

Sir H. Yule, in his edition of Marco Polo, (vol. II., 328–9), contributes a most valuable commentary on the above passage. Marsden, he says, was induced to suggest that the tree cotton of Marco Polo may have been *Bombax*. Commenting further on, Sir Henry adds that

Early records.

this kind of cotton appears to be grown in China, for a passage in Amyot's 'Mémoires' (II., 606) is as follows: 'Cotonniers Arbres, qui ne devoient être fertiles qu'après un bon nombre d'années.' But it is remarkable that an identical statement to that of Polo is given by Rashid-ud-din regarding Gujarat:—'the cotton plants grow like willows and plane trees, and yield produce ten years running.' Mahommed Masum, a later author, speaks of the cotton plants of Schwan in Sind 'growing as large as trees, inasmuch as men pick the cotton mounted.' The Rev. E. Terry, who accompanied Sir Thomas Roe's Embassy to India ('Voyage to East India in 1615,' p. 368), speaking of the neighbourhood of Surat, says:—'For their Cotton-wooll they sow seed, and very large quantities of Ground in East-India are thus seeded. It grows up like small Rose-bushes, and then puts forth many yellow blossoms; those afterward falling off, there remain little Cods, about the bigness of a Man's Thumb, in which the substance at first is moist and yellow; but as they ripen they swell bigger till they break their Covering, and after, in short time, that within them becomes Wool, as White as Snow, and then they gather it. Amongst that Wool they find seeds to sow again as they have occasion; but those shrubs bear that Wool three or four years ere they supplant them. Of this Cotton wool they make divers sorts of white Cloth.'

Graham (*l.c.*) refers to a cotton for which he proposed the name *G. Vaupellii*. This, he says, is found at Sidhpur, is a shrub eight to ten feet high and known as *hiragúnda-kápas*. Royle ('Cult. of Cotton,' pp. 144–5, 152), quotes Vaupell as saying that it was grown near the large towns of Eastern Gujarat and that 'its wool is the finest of any . . . and only used in the manufacture of the finest muslins.'

There is only one perennial cotton with yellow blossoms in Gujarat, and accordingly it seems safe to assume that it was the plant to which Marco Polo, Terry, and other early travellers referred.

Annual cotton a recent crop.

Here then we have another indication that the perennial cottons were once upon a time more largely cultivated than they are to-day, if we are not justified in believing that the perennial cottons were the early condition, the annual plant a product of greater skill in agriculture. Dr. Hove (170 years after Terry's time) repeatedly alludes to perennial cotton seen by him—both red and yellow flowered—but he also gives a full account of the cultivation of the annual plant, and devotes special attention to what he calls a new

method recently introduced. This may possibly point to a later extended production of the annual crop. But by the date of Hove's visit (1787) the *roji* cotton had been assigned the secondary position it has since held. Dr. Hove's specimens are in the British Museum, and it has to be admitted that they could not be separated botanically from any corresponding set of more recent date. Had Hove attempted to furnish particulars of the relative abundance of the various plants seen by him, his report would have been to-day of infinite value. But there is one circumstance that may be repeated, namely, that none of Hove's samples match the higher grade *kahnami* of to-day, and hence again a suggestion of their later introduction (or rather production) than the others, especially the *roji*.

Introduction of annual cotton.

Cultivation.—*Roji* cotton is met with on light soils, and mostly as a mixed crop—one row between ten or twelve of cereals. In the hot weather it is cut down to within one foot, and in the second monsoon it grows freely and yields its first crop in the incoming hot months.

Degeneration.—When left to grow in the hedgerows *roji* becomes sub-scandent, the wool shortens and turns rufous-coloured, and the fuzz lengthens and becomes also red-coloured. When left in the fields for more than three or four seasons the wool degenerates in quality, and, as stated by the early authors, is then fit for upholstery purposes only. But Professor Middleton observes:—'*Roji* is markedly different from the annual cottons and does not seem to hybridise with them. I have never seen any plant that might be taken as a cross. It strongly resembles *G. arboreum*, the chief difference being a yellow flower and the absence of the marked reddish tinge possessed by that species.' In *G. arboreum* it is the rule for the twigs, leaves, and bracteoles to have a purplish tinge in addition to the flowers being also purple (cf. p. 82); in *G. Nanking* these structures are usually green (cf. p. 134), but a pink tinge is characteristic of the *nadam* cottons, and in fact originated the name *yerra* as applied to them (cf. p. 128). One more circumstance may be here added regarding *roji* cotton—the pollen-grains appear dominant. Usually only one form and size is met with (**see Plate No. 53, f. 12**), and that so very different from the grains in either *G. arboreum* or most other forms of *G. Nanking* as to convey the impression of its being fully established, a dominant state, that demands independent recognition in all breeding experiments.

Short red wool.

Soudan cotton.

21. Var. soudanensis, *Watt.*

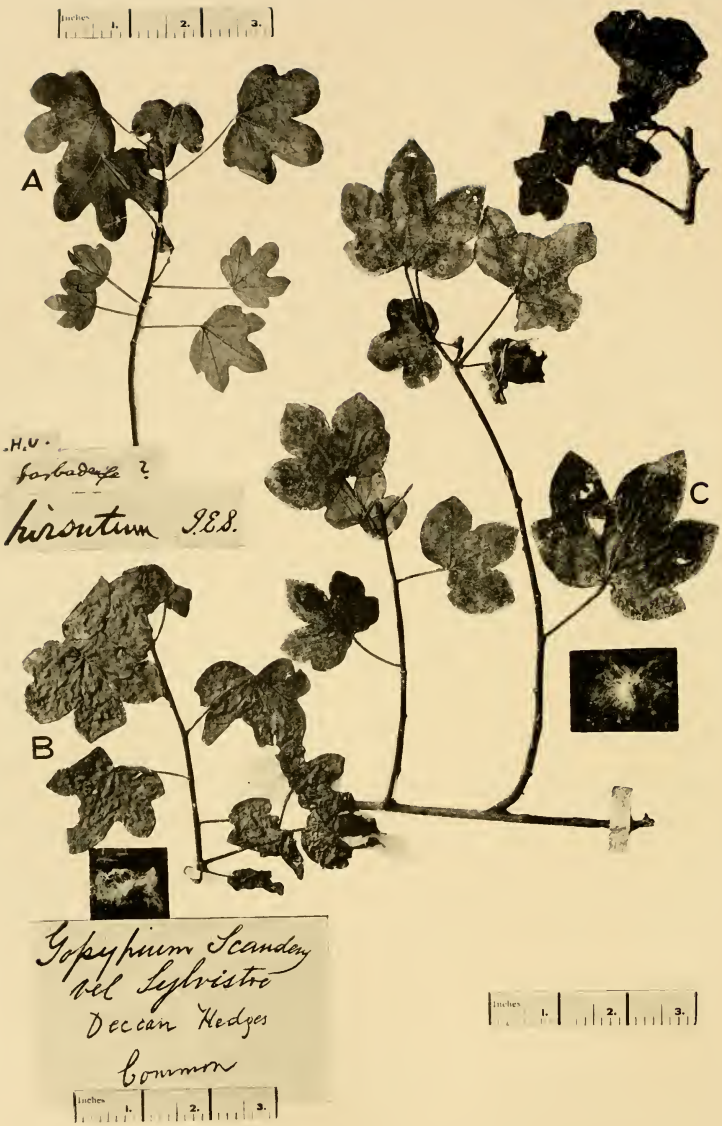
Mr. Broun has recently contributed a specimen (n. 693) of a plant which he calls 'Soudan Country Cotton.' A further specimen of what I take to be this same plant has been furnished to me by Mr. W. Lawrence Balls (n. 213–2) of the Khedivial Agricultural Society, and the note which accompanies the last mentioned speaks of it as one of the tree-cottons of Senaar. This, while closely allied to the *roji* of Gujarat, differs sufficiently to make me believe one or two special African forms might with advantage be regarded as separable from the corresponding Indian races to warrant their being given distinctive names. I refrain, however, from attempting to take this step at present, owing to want of sufficient material and data. I have provisionally placed certain African and other specimens under *roji*, but think it as well to isolate the present Soudan plant.

Description.

Soudan indigenous cotton is a large perennial bush with the leaves quite glabrous, deeply segmented and having supplementary lobes, also one to three glands below. Inflorescence axillary, bracteoles broad ovate, two-thirds of the cordature united, and margin deeply laciniate. Seeds large, coarse, ovate obtuse, with copious brownish-grey fuzz and a fair quantity of harsh woolly floss.

In shape of leaf this comes nearer to *G. arboreum* than to *G. Nanking*. But a yellow-flowered *G. arboreum* with deeply laciniate bracteoles and three glands on the undersurface of the leaf would destroy the specific isolations, while these peculiarities would not be difficult of acceptance as denoting a form of *G. Nanking*, more especially since the present plant possesses many other features strongly suggestive of that species.

General Characteristics.—To conclude this account of the forms of *G. Nanking*, it may have been observed that I have not attempted to describe the races that might be mentioned as examples of each of these varieties, *himalayana*, *rubicunda*, *Nadam*, *Bani*, *Roji*, and *soudanensis*. The races that can be assorted under these cannot be regarded botanically as anything more than sports or hybrids, but an infinite series of them exists, sufficient to almost connect *G. Nanking* with *G. arboreum* on the one side, and with *G. obtusifolium* on the other. In the localities where fairly extensively produced, some of these are, however, well known, and have been so for many years, because they afford recognisable trade qualities of staple. But it is next to impossible to furnish descriptions that would be intelligible



No. 19. GOSSYPIUM OBTUSIFOLIUM, *ROXB.*

(A) Specimen in Linn. Herb. Lond. named by Linnæus '*barbadense*?' and corrected by Smith into '*hirsutum*': on the same sheet is also a specimen of *G. herbaceum* (which see No. 24 C); the letters H. U. stand for Hort. Upsl.; (B) the oldest known example from India; (C) specimen collected at Junagardh, Kathiawar.

to persons who have not a personal acquaintance with the living plants. To the cultivators of India, China, and Africa they are, however, of considerable value.

As varieties and races of *G. Nanking* have to be classed all the yellow-flowered perennial plants with thick leathery leaves (often possessed of three glands), and which have small, thick, sparsely-toothed bracteoles.

22. G. OBTUSIFOLIUM, ***Roxb.***, *Fl. Ind.* (1832), *vol.* III. 183; *Tod., Rel. Cult. dei Cot.*, 1877–8, 129–30; *G. HERBACEUM, Aliotta, Riv. Crit. Gen. Goss.*, 1903, 67; *G. OBTUSIFOLIUM, Roxb. (in part), I. H. Burkill in Mem. Dept. Agri. Ind., vol.* I. *No.* 4. (Cf. *G. Nanking*, p. 117.)

Description.

A shrubby, very ramous plant, with small leaves, having three, rarely five, obtuse entire lobes, stipules falcate; bracteoles entire; capsule ovate, cells 3-seeded; seeds free, clothed with firmly adhering short, greenish-grey down under a small portion of ash-coloured wool. A native of Ceylon, but not cultivated. Flowered during the rains and cold season in the Botanic Gardens at Calcutta **(see Plates Nos. 19 and 20).**

It may now be useful to furnish a detailed description of this wild (or long acclimatised) plant:— *Stem* slender, branches round, brownish-red, glabrous below, but above clothed in minute, soft, stellate hairs that become almost spreading on the leaf-stalks; *leaves* thin, smooth, compact in texture, drying in the herbarium into an ashy-green colour, minutely reticulate with small dots within the meshes, sparsely and minutely stellately pilose, especially on the veins; 1 to $1\frac{3}{4}$ inch long and nearly as broad, mostly 5-lobed (occasionally only 3-lobed), lobes almost obovate oblong, very slightly constricted below into the sinus but suddenly and minutely bristle-tipped or emarginate, base cordate but scarcely auriculate, one obscure gland on the lower third of the central vein; petiole 1 to $1\frac{1}{2}$ inch long, slender, ascending, often almost woolly and pink-coloured or sub-glandular at the insertion within the blade; *stipules* minute, awl-shaped, caducous. *Inflorescence* strictly axillary, slender lateral shoots, with the common peduncle 1 to 2 inches long and bearing one or two small, usually 3-lobed, leaves, pedicel very short, sometimes only $\frac{1}{2}$ inch long; *bracteoles* united to each other only very slightly, say $\frac{1}{8}$th inch, but firmly adherent to the base of the calyx tube, not very profoundly cordate, thick, ovate acute, almost entire or coarsely toothed, prominently veined and reticulated, also gland-dotted and very minutely stellately hairy. *Calyx* irregularly 5-toothed, teeth large, rounded, and three glands at its base within the upturned and united margins of the bracteoles. *Corolla* with short tube and petals only very slightly attached, limbs wide-spreading, making the flower convolvulate, with the petals rotating to right, bright yellow with dark purple, very large spots on the claws and purple tinge on passing maturity, hairy outside,

especially along the outer margin. *Fruit* hardly exceeding the accrescent bracteoles, ovate, suddenly acuminate, and beak often deflexed or hooked, 3-celled. *Seeds* very large, irregular, ovate rotund, with dense fuzz of rufous or grey colour and with a sparse coating of coarse, rigid, reddish-white wool.

Oriental species.

Habitat.—A distinctly Oriental species met with in India, Ceylon, Malay Archipelago, but distributed to the Philippine Islands, Africa, and Upper Egypt.

The specimens from which the original description was made were cultivated in the Botanic Gardens, Calcutta, from seed obtained from Ceylon, of a plant reported to have been there wild. No wild plant that could be supposed to correspond with this species is, however, described or mentioned even in Linnæus, 'Sp. Pl.' or 'Fl. Zeyl.'; in Burmann, 'Thes. Zeyl.'; in Rheede, 'Hort. Mal.'; nor in Rumphius 'Amb.,' &c., &c. But curiously enough there is a specimen in Linn. Herb. (the property of the Linnean Society of London) that I take to be this very plant. (See photographic reproduction, **Plate No. 19 A.**) Lastly, Trimen says there is no indigenous cotton in Ceylon.

The plant which I here accept as having been described by Roxburgh yields, however, the Surat, Broach, Kathiawar, and Kumpta cottons—the so-called long staples of Indian commerce. It is, in other words, one of the stocks from which the best cultivated cottons of India and Africa have been derived, and is the plant which, in the Linnean Herbarium (**see Plate No. 21 A**), bears the name *G. hirsutum*, but is not the *G. hirsutum, Linn., Sp. Pl.* (which **see Plate No. 29 A**).

Indian wild cotton.

Citation of Specimens.—I have in India repeatedly collected a wild or self-sown *Gossypium*, and was, I believe, the first to definitely suggest its identity with *G. obtusifolium, Roxb.* The particular plant to which I refer occurs, for example, here and there all over Kathiawar. It literally envelops the old fort of Junagardh and the subterranean Buddhist palaces of that neighbourhood. It is common on the sacred Jaina hill of Palitana growing among the indigenous scrubby vegetation, where, for some centuries possibly, there has been no cultivation. It is fairly common in the hedges of Gujarat (especially near Wankaner, Mangrol, and Ahmedabad, R.E.P., nn. 1,733, 1,753, 1,772, 1,787, 1,788, 1,791, 1,837, 1,839, 1,884, &c. &c.), and was found by me in Khandesh and in the Deccan, especially near the Buddhist cave temples of Elúra and Ajunta. If in all these instances it has to be regarded as but a survival of former cultivation, there would seem every likelihood that in some of its known habitats it has existed in that condition for a great many years, perhaps centuries. Further, the plant is easily recognised from all the other Indian cottons, though certain states of *G. Nanking* come very near to it indeed, if such are not hybrids

Wild cotton of Gujarat.

No. 20. GOSSYPIUM OBTUSIFOLIUM, *ROXB.*

Photographic reproduction of the Kew Gardens copy of Roxburgh's original MS. illustration named "1495 (1493) Gossypium obtusifolium, R."; preserved in the Herbarium Library, Royal Botanic Gardens, Calcutta.

between the two species. From a very extensive collection of Indian *Gossypia* I can without difficulty, however, pick out all the examples of *G. obtusifolium* (as here accepted) that have been recorded as found in uncultivated positions. But it is not confined to India, since it is plentiful in Africa. Moreover Vidal collected it in the Island of Ticao, Philippines; the label attached to his specimen (n. 2,184) describes it as 'wild.' One from Madagascar in Baillon's herb. (n. 128) could not possibly be separated from the wild plant of Gujarat. Riedel found it in Letti and Lakor in the Malay Archipelago, and his specimens were communicated by Dr. A. B. Meyer in 1883.

I have already alluded (pp. 117 and 127) to the fact that Mr. Burkill regards certain sheets in the Calcutta Herbarium as 'type-specimens of Roxburgh's *G. obtusifolium*.' Through the kindness of Captain A. T. Gage, Superintendent of the Royal Botanic Gardens, I have just had these very specimens sent to me for inspection and find myself under the necessity to dissent from Mr. Burkill's opinion. On one of the sheets in question I recorded, in 1887, a note to the effect that it was a hybrid; I now endorse that view, as in all probability correct. These 'type-specimens of Roxburgh's *G. obtusifolium*' I regard as *G. Nanking*, *var. rubicunda*. They represent what might be spoken of as one of the numerous crosses, often seen in the Chinese, Japanese, Indian, and Malay cottons. And, as I have shown, there is nothing to prove that these sheets were culled from even hybridised descendants of Roxburgh's stock of *G. obtusifolium*. In the Wallichian herbarium there are several sheets marked H.B.C., but none of them are *G. obtusifolium*. In fact, so far as I have been able to discover, there is no authentic type of Roxburgh's plant in existence in any herbarium, and the plate and description here reproduced must be therefore accepted as the only standards to go by. At all events, should the specimens in the Calcutta Herbarium cited by Mr. Burkill be admitted as falling within the species *G. obtusifolium*, they can never be upheld as Roxburghian types, since they bear no such record. But their acceptance as manifestations of the Roxburghian species would very possibly necessitate the suppression of *G. Nanking* (being replaced by *G. obtusifolium*) and the promotion of *G. Wightianum* to specific value, to embrace the wild plant of Gujarat and all the finer cottons of Western India. From my point of view this would be of no serious consequence, since to the cotton-grower it is of little moment which name be used, so long as the existence of what I call the Chinese series of forms be maintained as distinct from the Indian.

Roxburghian type.

Nomenclature.—The above short description is abbreviated from Roxburgh's original account of the species, and the more detailed particulars have been drawn up from my own material. The existing information may accordingly be said to consist of a MS. coloured illustration, made under Roxburgh's supervision and named by him, the original of which is in the Calcutta Herbarium and an exact copy in the Royal Herbarium, Kew. I give, as **Plate No. 20**, a reproduction of it, photographed by the three-colour process, but reduced in size. As stated above, no authentic specimen of Roxburgh's

plant, so far as I have been able to discover, exists, however, in any herbarium. The plant has long since disappeared from the Calcutta Gardens and, as indicated, no other botanist has recorded the circumstance of its being a wild plant in Ceylon. In the sense advocated by me above it is, however, very largely the plant called *G. herbaceum* (or *G. herbaceum var. obtusifolia*) by most writers who have described the cottons of India and Africa. It has, on more than one occasion, been confused with certain forms of *G. Nanking*, more especially the variety (or race) called *rubicunda*.

Distinctive points.

Briefly, these two species may be separated—*obtusifolium*, the leaves cordate, the lobes short, more or less ovate-rotund, obtuse or acute, and the flowers yellow; *Nanking*, the leaves scarcely, if at all, cordate, the lobes oblong, often acuminate, and the flowers purple or with a purple tinge. In Roxburgh's coloured picture only a side view of the flower is given, but a pink tinge at the base of the tube is doubtless intended to denote the purple spots showing through the yellow.

Roxburgh's Flora.

Roxburgh was apparently not aware that it was a wild plant in Khandesh and Gujarat, nor that it was the type of the most important cottons of Western India. In the Kew Library is preserved a MS. copy of Roxburgh's 'Flora Indica,' which contains many corrections in his own handwriting, so that it can be accepted as authentic. It furnishes additional particulars, more especially details not given in the work actually published. Under the present species, for example (vol. II. 2067), after a full description, follows the remark: 'It is an ornamental shrub, but the wool is of a very indifferent quality and too scanty to render it an object of cultivation in its present state. It has, however, a good deal of the habit of *Gossypium herbaceum*, and may probably be the original stock from whence that species and its varieties have sprung.'

Under the name *G. herbaceum*, Roxburgh, in his published work, described the plant now accepted as *G. neglectum* and linked it with *G. Nanking* (China and Berar Cottons), but kept all three distinct from *G. obtusifolium*.

Deccan wild cotton.

In the Kew Herbarium (ex herb. Hooker) there is an Indian specimen that I accept as being the plant of Roxburgh's description and picture. This was collected in the hedges of the Deccan, and bears on the attached label the observation, '*Gossypium scandens vel sylvestre*.' **(See Plate No. 19, f. B.)** So also in Linnæus' Herbarium (Linnean Society, London) there are three sheets of

specimens that I recognise as very possibly Indian plants. One of these bears two specimens: the right-hand one (shown on **Plate No. 24, f. C**) is, I have little doubt, *G. herbaceum*, obtained very likely from the Levant, and the left-hand one (shown on **Plate No. 19, f. A**) closely matches the Deccan plant just mentioned. Linnæus, accepting both as one plant apparently, wrote on the sheet '*barbadense?*', and Smith corrected that into '*hirsutum*'; but both determinations are equally incorrect. I believe the examples mentioned (Deccan and Linnean) are representative of *G. obtusifolium, Roxb.*

Indian and African cotton.

The plant occurs both wild and cultivated in India and Africa, and stands every chance to have been one of the most important strains, if not the most important, in the production of the best cultivated cottons of these countries. The leaf, as shown by Roxburgh's picture, is, however, distinctly 5-lobed, and the plant as known to me varies considerably in the degree of serration of the bracteoles. In the wild or self-sown plant of India the bracteoles are much more entire than in the corresponding plant in Africa, but it is possible that the variation in this direction is more a consequence of hybridisation and adaptation to environment than of specific characteristics. The bracteoles in the Indian plant bring to mind, in shape and attitude, those of *G. arboreum*, and in the African those of *G. Kirkii.*

Having briefly indicated the chief areas of this species, it may now be desirable to discuss the more easily recognised manifestations that exist:—

23. Var. Wightiana, ***Watt:*** *Tod., Relaz. Cult. dei Cotoni* (1877), 141–6, *t.* IV., *f.* 1–9; G. HIRSUTUM, *Linn., Syst. Nat.* II. (1767) 462, *et Herb., sed non Sp. Pl.*; G. HIRSUTUM, *Lam., Encycl.* II., 134 (*in part*); G. HIRSUTUM, *DC., Prod.* 1824, I., 456 (*non Linn. et excl. synn.*); G. HERBACEUM, *Linn.*, (*and in descriptive note* G. OBTUSIFOLIUM, *Roxb.*), *Wight, Ic., t.* 9; G. HERBACEUM, *Oliver, Fl. Trop. Afri.* 1868 I., 211 (*in part*); *Max. T. Masters, Fl. Br. Ind.* I. 1874, 346 (*in part*); G. HERBACEUM, *Engler* (*non Linn.*), *Die Pflanz. Ost. Af. &c.*, 1895, 386–7; *Mollison, Textbook Ind. Agri.* III. (1901), 215–24; G. HERBACEUM, *Aliotta, Riv. Crit. Gen. Goss.* (*in part*) 19, 0367.

The so-called Long Staple Cottons of India; Gujarat cotton.

Gujarat cotton.

Cultivated annual cotton; shrubs 1½ to 4 or even 6 feet high; whole plant coated with both stellate and long, spreading, simple

Description. hairs, which only partially fall off with maturity; leaves ovate rotund (in main shape), not very deeply cordate, lobes 5–7 (rarely 3), ovate oblong, acuminate, sinus between the lobes narrow and often thrown up in folds, one gland on central vein below; inflorescence sometimes forming proliferous lateral shoots (an important departure from the specific condition and a direct consequence of special selection doubtless); bracteoles relatively small, ovate acute, deeply toothed (never rotund or sub-reniform as in *G. herbaceum*); calyx obscurely toothed, teeth rounded; capsule ovate acute, usually 4-celled and with 8 seeds in each cell; seeds much smaller, more definitely and compactly formed than in the wild plant, and fuzz very short, usually ashy-grey in colour. **(See Plates Nos. 21 and 22.)**

Western India. *Habitat.*—Cultivated in a belt of country that fringes the west coast of India from the Rann of Kach through Kathiawar and Gujarat to the Southern Maratha country and South India. Varthema ('Travels, &c.,' 1510) speaks of the cotton of Cambay being much exported; he also says Bengal cotton is sent to Mecca, and in a footnote mentions the cotton of Burma. Mandelslo ('Voyages and Travels to the East Indies,' 1638–40) makes frequent mention of the cotton of Gujarat and Agra, but not in such a way as to allow any opinions being formed regarding the species. Rohr ('Observ. sur la Cult. du Cot.' 1807, pp. 62–4) classes this as one of his two forms of 'Nun's Cotton,' both of which he procured from India (the other was *G. arboreum*). He describes the present plant as having obtuse leaves, and says that he procured the seed originally from Cambay and was growing it in Sainte-Croix (the Antilles) in 1787. He further says that he had supplied the Royal Gardens of Copenhagen with fresh seed for experimental cultivation. There is thus nothing to prevent its having similarly been carried to Ceylon, perhaps by the Dutch.

Linnean specimen. *Citation of Specimens.*—It is perhaps the most useful course to enumerate the collections of this plant as far as possible under the names of the chief races. Since this, however, is not always possible, there remains an extensive series that might be mentioned under the present heading. Perhaps the most instructive specimen is that in the Linnean Herbarium (London) named *hirsutum*, and which was procured from Surat. **(See Plate No. 21 A.)** It would most probably be described as Gujarat *deshi* cotton. In the British Museum Herbarium there are many interesting examples, of which the following may be specially mentioned: Hove's specimen from Dholca Ahmedabad collected in 1787. **(See Plate No. 21, f. B.)** Colonel R. H. Beddome's *uppam*, collected at Kurnool; a specimen contributed in 1785 by the Moravian missionaries at the Nicobar Islands. This is a somewhat

No. 21. GOSSYPIUM OBTUSIFOLIUM, *ROXB.*, VAR. WIGHTIANA, *WATT.*

(A) Specimen in Linn. Herb. Lond. named '*hirsutum*' by Linnæus, the word 'Suratt' denoting locality whence obtained : is very like the *lalio* cotton of Gujarat to-day (cf. with the true *G. hirsutum*, Plate No. 29); (B) specimen in B. M. collected by Hove in 1787 : is much like *Wagria* cotton of to-day.

remarkable plant, possibly an extreme form of *G. Nanking var. Bani*, rather than the present. It is probable that it was being grown by the missionaries, since the Nicobaris at that time are not likely to have cultivated any cotton for their own use.

In the Kew Herbarium there are many samples that had better perhaps be mentioned under the paragraphs devoted below to the races of this plant. One may, however, be here specially mentioned, namely, a plant collected by Allan Cunningham in Australia, presumably from a field of experimental cotton raised from Gujarat seed.

In the Edinburgh Herbarium there are several interesting sheets: a specimen collected by J. Campbell in Madras in 1835, another by Dr. D. Ritchie at Belgaum in 1853, and a third by Schlagintweit at Kach in 1857, n. 11,244.

A recent cotton.

Nomenclature.—One of the most remarkable features of this plant is the circumstance that, while it is the most valuable of all Indian cottons to-day (and it might also be said of African cottons as well), it is the one least understood and last of all to be described by botanists. In fact no Herbarium in Europe could be said to even now possess a sufficiently extensive series to be of practical value. There is, moreover, no certain evidence that Roxburgh ('Fl. Ind.' 1832), who described the wild condition, was aware of the existence of the cultivated plant. There are undoubted specimens of it, however, in the Linnean Herbarium, but these (as already mentioned) have been named (and by Linnæus himself) as *G. hirsutum.*

Imaginary picture.

Many botanists have cited Plukenet's plate ('Phyt.' II. t. 299, f. 1) as being the present plant, but I am fairly satisfied that is a mistake. His actual specimen is in the British Museum, and I prefer to regard it as *G. Nanking*, though a remarkable and very exceptional form of even that species. The flower shown in the picture appears to have been drawn purely from imagination, and its presence caused the definition of the species to be modified and thus added seriously to the confusion that already prevailed.

Oldest specimen of Gujarat cotton.

Linnæus possessed, however, a good average sample of this cotton, though, as just observed, he incorrectly named it *G. hirsutum* and recorded the locality 'Suratt' alongside the twig, but omitted to mention that fact in his 'Species Plantarum' or to give the name of his contributor. **(See Plate No. 21, f. A.)**

Hove's specimens and opinion.

Lamarck, Cavanilles, Willdenow, Parlatore, and other authors all believed this Indian cotton to be either *G. indicum, G. hirsutum, or G. herbaceum.* But not one of them had any sort of practical knowledge of the Indian cultivated plant. It was collected by Hove in Gujarat in 1787, though, strangely enough, his remarks regarding it almost involve belief that it was then a new crop, or at least was

Kahnami, a recent form.

cultivated under a new system. It is even still more curious that his samples seem all much closer to the *wagria* than to the *kahnami* race, a fact that might be accepted as favouring the belief that the *wagria* is a more ancient stock than the *kahnami* and other higher-grade cottons. Under the race *Uppam* (below) it will be seen a passage is quoted from Royle in which he speaks of that cotton as coming nearer to the American Upland than does any other Peninsular cotton. This would, therefore, almost imply that even so late as 1851 Surat and Broach cottons were not regarded as the finest Indian stocks.

No examples of it in Sloane's Herb.

It is moreover most singular that there is no Indian example of *G. obtusifolium*, in any form, in the Sloane Herbarium of the British Museum, while cultivated states of *G. arboreum* and *G. Nanking* are plentifully represented from that country. It was not, in fact, until Todaro figured and described *G. Wightianum* that it can be said that the *kahnami* cottons of India were clearly and definitely recognised. He, moreover, correctly separated his *G. Wightianum* from *G. herbaceum*, but apparently in writing up the names of specimens he gave a wider signification to *G. Wightianum* than is implied by the description, since in his own handwriting there are specimens at Naples (especially in the Herbarium at Portici) named *G. Wightianum* that should be placed under *G. Nanking, var. himalayana.* Dr. Angelo Aliotta ('Riv. Crit. Gen. Goss.' Portici, 1903, pp. 59–65) reduces *G. Wightianum, Tod., G. indicum, Lamk.*, and *G. Nanking, Tod.* (*non Meyen*) to be hybrids of *G. arboreum* with *G. herbaceum.*

G. herbaceum not grown in India.

In the 'Dictionary of Economic Products' I accepted Todaro's position and advanced the opinion (here endorsed) that except as met with in Gilgit and Afghanistan *G. herbaceum* proper is not cultivated in India. But I am now convinced that *G. Wightianum* is but a later synonym for a cultivated state of the plant Roxburgh described as *G. obtusifolium*, more especially since I have, on several occasions (subsequent to the date of the Dictionary), collected that plant in at least a semi-wild condition and within the very area of its present-day special cultivation. If *var. Wightiana* be accepted as but a hybrid, its ancestors are likely to have been *G. obtusifolium* with very possibly *G. Nanking* or in some forms *G. arboreum.*

Hybrid stock.

Bearing in view the distribution of the plant, it might easily be anticipated that the cotton of Ceylon would be more like *G. obtusifolium* than any other Asiatic species. It is thus quite possible that the seeds sent to Roxburgh were collected from

plants that were accepted as wild, even although it has not been since recorded as met with in Ceylon. I have seen undoubted specimens of it from Africa, the Philippine Islands and elsewhere, all described by the collectors as wild, and there is, therefore, no very potent reason against acceptance of Ceylon as being even an original habitat, even although it apparently no longer exists in that country. Distribution to other countries.

Cultivation.

Forms Grown.—The cultivated states of *G. obtusifolium* are exceedingly difficult to classify, since they blend almost imperceptibly from one type to another, in direct adaptation to smaller and less conspicuous climatic and soil variations, than are experienced in the other cotton areas. Adaptations.

As already explained, my studies of this most troublesome genus have led me to suppose that if any two forms of cultivated cottons can, or should, be separated, *G. herbaceum* had better be accepted as distinct from *G. obtusifolium*. There are, moreover, in India three main classes of cotton soils, with three corresponding main groups of cotton plants:—(*a*) Rich black loamy soils, such as those of Kathiawar, Gujarat, Khandesh or the Karnatic, which are collectively often spoken of as possessing 'Black Cotton Soils.' (*b*) Mixed red and black stony soils, such as those of the Deccan, Berar, the Central Provinces, &c. (*c*) Alluvial sandy soils, such as those in the Ganges and Indus basins. Within (*a*) the forms of *G. obtusifolium* are mainly grown: (*b*) the forms of *G. Nanking*, and (*c*) of *G. arboreum*. Influence of soil.

But in each of these great cotton areas there may be local modifications both in climate, soil, exposure, &c., so that a limited cultivation of all three plants may exist or be possible in any one province. Speaking generally, however, *G. Nanking*, when met with on the black cotton soils, is of a superior quality to that seen anywhere else, and *G. arboreum* is there very nearly unknown. These soils are too valuable to be used for the inferior grades, and consequently it is within *G. obtusifolium* itself, as a rule, that the adaptations of plant to environment have taken place. Degenerations.

On the red and black stony soils, *G. obtusifolium* rapidly degenerates or becomes hybridised with *G. Nanking*. In the areas of sandy dry soils *G. obtusifolium* becomes unknown, and the higher grades there met with are some of the stocks or hybrids of *G. Nanking*.

It is not to be wondered at, therefore, that in regions so eminently suited for cotton as those possessed of the black cotton soils, every little variation in soil, climate, altitude, marine influence, &c., &c., should have resulted in the production of special forms, adapted district by district, if not field by field. The most favoured conditions, and the localities accordingly of the finest Indian staples, are Surat, Broach, Ahmedabad, and Kathiawar. But within even these four districts there are well-marked minor areas that have apparently directly originated some of the special forms of *G. obtusifolium* that have presently to be indicated.

Localities of best cotton.

In 1891, and again in 1894, I had the pleasure of studying the cottons of Gujarat, and, on the last occasion, in company with Professor Middleton (now of Cambridge), who was at that time in the service of his Highness the Maharajah of Baroda. We marched from field to field, over the greater part of the provinces of Gujarat and Kathiawar (when the cottons were in flower), and Professor Middleton's great personal knowledge of the country enabled him not only to point out to me the kaleidoscopic blendings of the plants but the immediate relationship of these to the variations in soil. (Cf. 'Ann. Rept. Ind. Museum,' Calcutta, 1893-94, pp. 2–5.)

Kahnami area.

The rich, deep black soil of Broach and Navsari is known as the *kahnam*, and this was seen to produce the finest of all Indian staples, accordingly called the *kahnami* or Broach *deshi* (= country) cottons.

In Milburn's 'Oriental Commerce' (1813, i. p. 280) special mention is made of the Ahmood cotton being at that time the finest grade of Surat cotton.

Goghari area.

The districts south-east of Baroda were noted by me to produce a considerably lower grade of *kahnami* cotton. So also both sides of the Dhadar river (between Baroda and Broach) were seen to change into a calcareous loam with the appearance of a distinctive plant known as the *goghari*. That particular cotton thus occupies an intermediate zone between the plants of the deep black *kahnam* soil proper and the lighter or shallower soils known as *goradu* to the north and west. On these lighter loamy soils are to be found the *kanvi* cottons of Bhavnagar, Palitana, Dholca, Amreli and Junagardh; the *ambli* (of Dhollera) and the *wagria* of Wadhwan, Viramgam, Morvi, North Kathiawar and Kach.

Kumpta area.

A similar classification doubtless prevails in the southern Maratha country. The Kumpta (Coompta) cottons of Dharwar and Belgaum are the southern equivalents of the *kahnami* cottons of

Gujarat. Still further to the south (in the Madras Presidency) the *uppams* of Tinnevelly, Coimbatore, &c., closely correspond with the *goghari* cottons, while the *tellapatti* or *jowari-hatti* (hybrid) cottons of Bellary and Kurnool in some respects answer to the *wagria* of North Gujarat.

Much useful information on the cotton (cultivation and trade) of India will be found in Lord Auckland's Minute published in 1839, and the following works may also be consulted with advantage :— *Briggs, The Cotton Trade of India, Royal As. Soc.* 1839, *pp.* 1–88, *with map ; Chapman, The Cotton and Commerce of India,* 1851 ; *Royle, Culture and Commerce of Cotton in India,* 1851 ; *Cassels, Cotton in Bombay Presidency,* 1862—*a volume of* 800 *pages in which the name Gossypium is not even mentioned ; Wheeler, Handbook Cotton Cult. Madras ; Shortt, Prize Essay on Cotton Cult. in India,* 1862 ; *Mallet, Conditions Involved in Successful Cult.,* 1862 ; *Rivett-Carnac, Repts. Cotton Dept.* 1867–9 ; *Maddox, Essay on Cult. of Cotton* (*Journ. Agri. Hort. Soc.* XIII ; *Walton, Hist. Cotton in Belgaum,* 1880 ; *Beaufort, Cotton Production and Trade of India,* 1902–3. Indian publications.

Races.—The Indian cultivated states (races) of this plant show sufficient distinctive features to warrant their retention in a position by themselves—that is to say, apart from those of Africa and other countries. I have, therefore, accepted the name *G. Wightianum* for the Indian series collectively, partly because, since Todaro's day, that name has come largely into use, and partly also because none of the Indian vernacular names are comprehensive enough to include the extensive assemblage of races that it is now desired to indicate very briefly : Indian races.

(A) Probable Pure Races.

(a) *Kahnami* : The *deshi* cottons of Broach, Surat, Navsari, Baroda, &c. The plants of this set are larger and more vigorous, than is the case with any other Indian cotton. *Stems* well formed, but sparsely branched ; *leaves* larger and broader (more like those of *G. herbaceum*) than is customary in India ; *flowering-branches* mostly elongated secondary shoots (proliferous), with solitary axillary flowers, often pendulous ; *peduncles* deflexed, so that the fruits become pendant ; *glands* on the apex of the peduncle often very large, those on the calyx within the bracteoles often absent ; *corolla* very often relatively short, and suddenly and widely expanding ; *pods* triangular in section, abruptly acute, and with deep depressions between the septa ; *floss* very soft and silky, separating easily from the seeds, but does not protrude much from the pod, and, owing to the small size of the bracteoles, is usually remarkably clean. Descriptions.

This most important and valuable plant is found on deep, black soil ; is sown in June, and harvested in January to March. A good crop may

yield from 400 to 500 lb. of seed-cotton per acre. The following record of specimens in the Herbarium of the Reporter on Economic Products, Calcutta, may be useful:—Broach series, nn. 1223, 1878, 1883, 1889, 1890, and 1895; Surat series, nn. 1709, 1715, 1731–2, 1876, 1880–2. In this neighbourhood escapes from cultivation may be seen in the hedgerows, or as survivals of last year, growing among other crops, but except in having smaller, less hairy leaves, and larger, more reddish-coloured bracteoles, no other differences are usually observed. These are precisely, however, the departures noted when Broach or Surat *deshi* seed is sown on poor soils. (See Plate No. 22, f. A.)

Baroda-Broach cottons.

(b) *Goghari*: One of the lower grade but profitable cottons of Baroda and Broach. Is an extremely local race, and as already indicated is met with on a narrow belt of calcareous soil in Baroda and Broach, as also, to some extent, in Rajpipla State. The plant so closely resembles the *kahnami* that, until the bolls form, the two can hardly be distinguished. It is, however, a more robust plant, possibly (as Professor Middleton points out) because of its being grown on a better-drained soil. The tertiary shoots are rarely proliferous, but occur rigidly along the secondary branches and bear only 2 to 3 flowers. The bolls are globose, and much larger than those of the ordinary *kahnami* race, but the seeds are correspondingly larger, darker coloured, and possess a more copious coating of velvet (fuzz), while the wool adheres more firmly to the seeds, and is whiter in colour, more woolly, but very much more abundant. It has the advantage of being successfully grown on soils where *kahnami* is less profitable, but both plants are often grown in the same field, the more copious supply of *goghari* being practically an adulterant with the *kahnami*. The following examples may be mentioned in the Herbarium (R.E.P.), nn. 1716, 1717, 1724, 1752, and 1830.

Dhollera cottons.

(c) *Lalio*: This is the *deshi* cotton of Ahmedabad and Kathiawar—Dhollera cotton. It might be described as an inferior grade of *kahnami*, found on light loamy soils, but it is a taller and more robust plant than the typical *deshi* of Broach. In Kathiawar the pods are deflexed and the valves reflexed, so that the floss protrudes from the ripe capsule to such an extent as to have suggested the name *lalio* (saliva-like), but in some localities this peculiarity is not well marked. Owing to the protruding of the cotton and its falling to the ground it gets very dirty from dust and dried leaves adhering to it. A field of ripe *lalio* cotton—such as that photographed by me near Junagardh, with the Girnar hills forming the background—is very beautiful, and looks almost like a field of snow. (See my paper on 'Cotton Improvement,' in 'West India Committee Circular,' vol. XIX., 1904, p. 144.) The name *lalio* (or *lahrio*) is applicable to the *deshis*, *kanvis*, and *kanpuris* of the south, and to the *bhalia* cotton (Ambli, &c.) coming from the Bhal country on the east. In fact a Kathiawar cultivator would describe all the cottons grown between Ahmedabad and Navsari as being *lalio*, and that is very nearly the view I take. I am unable to see any difference between the *lalio* of Ahmedabad and *asul deshi* (or Kathiawar *deshi*). The latter has a more silky floss, but there are many grades in the collective series to which I give the name *lalio*. Of these may be mentioned the Ambli and Sakalio cottons, also the *deshi* (or *mathio*) Bhavnagar, Palitana, Junagardh, and Gondal, which all differ very slightly, according to value of soil and care in cultivation, but not,

M. Smith delt, J N. Fitch lith.

West, Newman imp.

No. 22. GOSSYPIUM OBTUSIFOLIUM, *ROXB.*, VAR. WIGHTIANA, *WATT.*

A.—1, Flowering branch *Kahuami* Cotton; 2, portion of leaf showing stellate and elongated hairs; 3, stellate hairs; 4, *Lalio* boll. *B.*—1, Leaf of *Wagria* Cotton; 2, closed ripe boll of *Wagria*.

I venture to think, racially. They are collectively the Dholleras of commerce. In the R.E.P. Herbarium there are, among many others, the following examples—nn. 1738, 1765, 1805, 1821, &c. (See Plate No. 21, A—Dr. Hove's sample—and also Plate No. 22, A 1–4.)

(d) *Kumpta*: This is the characteristic cotton of the Southern Maratha country, known in trade as '*Coomptas*.' As already explained, it is closely allied to the *deshi* cottons of Broach, Surat, and Baroda. In fact it is impossible to furnish any particulars by which the two plants could be separated in the herbarium, and yet they are geographical forms that have never been successfully interchanged, and the staple of the Gujarat series is of a far higher quality than even the best of the Southern Maratha. As a rule the *Kumpta* plant is much branched, and the leaves thicker and more hairy than in any of the Gujarat forms. The bracteoles are much smaller, and only dentate on the apex, and the corolla is in consequence relatively larger, and pale yellow with very deep purple blotches. The capsule is small, ovate, 3-celled, and the seeds possessed of a yellowish-grey fuzz. But it has the advantage of maturing much earlier than is the case with the corresponding Gujarat stock (see R.E.P. Herb., n. 21,864). Kumpta cottons.

(e) *Uppam*: This may be described as the long-staple cotton of South India, and found mainly in Tinnevelly and Coimbatore. As already explained, it closely resembles the *goghari* of Gujarat, but is much inferior in the percentage of floss to seed. The plants are vigorous, but less productive. Uppam cottons.

Royle speaks of the *uppam* (or *ukkam*) cotton as an annual which grows on the black, or richest, and highest-assessed land. It is said to be called *uppam-parthi*—literally, sea-breeze cotton, from opening its bolls after the setting in of the sea breeze. The following specimens may be enumerated:—*ukkam parthi chedi*, nn. c.1, c.5, c.8, and c.15; and R.E.P., n. 21,870. The staple, according to Royle, comes nearer to that of American Upland than does any other Peninsular cotton. Now, if that statement was true in 1851, it is certainly not true to-day, and the explanation must, therefore, be that it has much degenerated since the time when Dr. Wight supervised the cotton cultivation of South India. But Royle's remark may have special reference to hybrids of the *uppam* with Bourbon cotton or with New Orleans, such as the black-seeded, presently to be described under *tellapatti*. The only other possible alternative theory is that the cottons of Gujarat have relatively vastly improved.

(B) Probable Hybridised Races.

(f) *Kanvi*: This would appear to be a recently introduced stock, and it often bears the name *Khanpuri*. It might be fairly well described as a form of *goghari*; it bears, at all events, the same relation to the *deshi* of Kathiawar that *goghari* bears to the *deshi* of Broach. It is a low grade cotton that yields very freely, hence its popularity. From the name *Khanpuri* it has been supposed to have come from Eastern India, but if Cawnpore be meant, there is certainly no cotton in that district that could for a moment be supposed to have been the original stock of the *kanvi* (or *kanbi*). It is much more likely to be the *deshi* of Kathiawar, or even of Baroda, hybridised with *var. neglecta* (*belati* or *varadi*); but if so, it is a cross that has preserved the foliage and other structural peculi- Kanvi cotton. Kathiawar cottons.

arities of *G. obtusifolium*, and taken only the profusion of short woolly cotton from the other stock. It is the inferior cotton of North Gujarat and Kathiawar. The following specimens may be cited:—From the Herbarium R.E.P., nn. 1759, 1764, 1801, 1809, 1812; also 21,863.

N. Gujarat cottons.

(g) *Wagria*; A common cotton in North Gujarat and Kathiawar, also found in Kach. The readiest eye-mark for this cotton is its globose fruit, which never fully opens with the ripening of the crop, so that the floss does not protrude more than partially. It bears several vernacular names which often denote localities, such as *Wagadio*, *Wadhiaro*, *Kanmiri*, &c. It is common around Wadhwan, Mangrol, Verawal, Botad, Wankaner, Gondal, Wawani, Morvi, Kach, &c. The specimens in the R.E.P. Herbarium, Calcutta, that may be specially mentioned are nn. 1747, 1795, 1822, 1832, 1845, and 1871.

Wagria cottons.

Description.

A small, erect, sparsely-branched bush, usually 18 to 30 inches in height, is grown on light soils, requires much less moisture than most of the above races, occupies the soil for eight to nine months, and may even be found on the fields for two or three years. It is much less hairy than is customary with *G. obtusifolium*, the older leaves being thick, dark green, glossy, almost glabrous, and veins pale-coloured. Leaves ovate to sub-rotund, 3–5-lobed, cordate; lobes broad ovate, obtuse or acute. Bracteoles less than half the length of the corolla, broad ovate, cordate, dentate, or sub-entire, spreading as the flowers open, and petals rotating to left. Bolls smooth, globose, mostly 3-celled, valves very broad, only partially opening with maturity. Seeds fairly large, coated with yellow to brown fuzz, and with coarse woolly floss, much as in *goghari*. (See Plate No. 21, f. B, also No. 22, ff. B 1 and 2.)

Hybrids.

To the south of the *wagria* cotton area the plants met with gradually merge into the *kanvi* cottons, above defined. In fact, Professor Middleton thinks that the crossing of *wagria* with *deshi* Broach may have originated both the *khanpuri* and the *goghari* cottons, plants with round bolls that only imperfectly open. But it is possible that *wagria* is itself a hybrid between the *deshi* of Broach and the *bani* of the Central Provinces and Berar. This suggestion would accord with the broad, rounded leaves (much as in the wild forms of *G. obtusifolium*), their less hairy condition, the prevalence of the plant in dry regions, as also the tendency to become perennial. It is highly probable, however, that further hybridisation originated the *Khanpuri*, if not also the *goghari* and other intermediate forms that exist. In Verawal a cotton named *lalio* by the cultivators (n. 1774–5) is almost *roji*, and has even a tooth in the sinus and the pods are oblong, while another sample, collected at Morvi, and named *dabalio*, is much closer to *G. Nanking* than to typical *wagria*, but has the round closed fruits of that plant. *Deshi Amod* (n. 1723) is exactly intermediate between *G. Nanking* and *G. obtusifolium, var. Wightiana*. In fact every intermediate state exists between both supposed ancestors of the *wagria* cottons. Dr. Hove's samples of Gujarat cottons preserved in the British Museum are (as already stated) much closer to the *wagria* type than to the modern *kalnami* cotton.

Tellapatti cottons.

(h) *Tellapatti*: This is the black-seeded cotton of South India that is often called *jowari hathi*, and which is found in Bellary and Karnool. There would seem little doubt that this is a naturally-produced hybrid between the *uppam* and Bourbon cottons. The seeds may be devoid of fuzz (black *jowari hathi*), or have only a small tuft of fuzz near the beak, or be

completely coated with fuzz (white *jowari hathi*), but the same seed on germination may produce any or all of these three conditions. These are therefore splitting recessive forms. A sample sent to me from Tinnevelly is called *vellai-kanni-parthi-chedi.* Tellapatti cottons.

Professor Middleton (*l.c.* p. 7) was apparently the first of the recent scientific writers who drew pointed attention to this plant and to the peculiarity of its seeds. On Middleton's receiving a packet of seed he concluded that the black seeds were Bourbon cotton and accordingly picked them out and sowed them separately. They produced identical plants with the white seeds, but on studying the living plants he came to the conclusion that they manifested no trace of a Bourbon hybrid. To that opinion I must demur. The leaves are broader, more deeply cordate-auriculate, more frequently 3-lobed, the bracteoles more fully united and more accrescent, and the pods much longer and more pointed than is customary with *uppam* cottons. While assorting the specimens in my possession, and without having observed the names on the labels, I placed the proliferous shoots of this plant alongside of *G. hirsutum, Linn., var. religiosa.* (See specimens in R.E.P. Herb. nn. 21,872 and 21,873 and compare with the white-seeded nn. 21,868 and 21,869.) A closer study, more especially in view of the known acclimatisation of Bourbon cotton in South India, seemed to justify the transference of the *tellapatti* cottons to the position of undoubted hybrid states between the so-called Asiatic and American stocks. The fact of the stems, foliage, &c., being much more densely coated with hairs than in the *uppam* ancestor is but an illustration of the special and often inexplicable strength manifested by hybrids. Hybridisation with *G. hirsutum* and *G. obtusifolium* would not likely give a naked seed, but the similarity of such hybrids may throw a useful sidelight on the possible origin of some of the races of cultivated cottons. Hybrids from *G. purpurascens* (Bourbon cotton) with *G. obtusifolium*, while doubtless difficult to form, have been produced and come in my opinion very close to the *jowari hathi* cotton above indicated. It would thus seem highly likely that the appearance of fuzzy seeds among the black-seeded *jowari hathi* but demonstrates that the fuzz is the recessive ancestral condition to the dominant naked seed. Description. American × Asiatic hybrids.

24. Var. africana, ***Watt.*** Lobes of the leaves a little more drawn out and more constricted below; bracteoles ovate sub-rotund, coarsely toothed around the margin, firm in texture and with the fuzz on the seeds usually pure white or grey, and the wool more copious and finer than in the Indian forms. **(See Plate No. 23.)** African form.

Citation of Specimens.—The best examples of this seen by me in the Kew and British Museum Herbaria are : South Africa : E. E. Galpin, 1890, n. 742, shrub found in the 'Kaap River Valley at Barberton, alt. 2,000 feet'; Dr. A. Rehmann's n. 5227 from the Boshveld, Transvaal (leaves a little more apiculate than is customary); M. Rautanen's n. 59, Omboland; W. Goetze's plant n. 75 from Nyassaland (leaves small, sub-glabrous); H. Bolus's n. 7680, 30 miles from Delagoa Bay; Mrs. Lugard's n. 198, from the Kwebe hills, Ngamiland (**ff. B & C**). This is described as a spreading bush, 4 feet. The bracteoles are remarkably like those of *G. Kirkii*, otherwise it is Specimens.

Specimens.

exactly the Indian plant. CENTRAL AND WEST AFRICA.: Rev. J. Stewart's plant collected in the Zambesi country (fuzz rufous); Livingstone's and Kirk's specimens, Zambesi Exped. n. 283; Barter (? Mipe); Perrottet, Senegal also Brunner, plant from the island of St. Ludovic, Senegal (leaves very small and plant almost glabrous); Banks of Komadugu Waube near Geidam, N. Bonna, N. Nigeria, W. R. Elliott, n. 135. UPPER EGYPT.—White Nile, lat. 9°.14, Petherick, 1868, 'not cultivated, probably introduced'; C. E. Muriel's n. 51, collected within the White Nile basin, 'probably an escape from cultivation'; Kordofan, Dr. Pfund, n. 474 (Coll. Egypt General Staff); Darfour, coll. (État-Major Général Égyptien), n. 61; Wilkinson's 'wild cotton' from the oases of Egypt (fuzz white); Schweinfurth's Suakim cotton n. 1607, with large seeds having a green fuzz—possibly a cultivated state; French Guinea collected by Leo Farmar, n. 218, cultivated near Kindia and Timbo. Fruit four-celled, fuzz almost rufous and wool harsh.

African herbaceous cottons.

Cultivation and Cultivated States.—Several botanists have collected in Africa cultivated plants which can hardly be separated from the Indian series that I have placed under *var. Wightiana*. It is, however, convenient as a geographical circumstance to keep them distinct. But there are many specimens in not a few herbaria that might easily enough be passed off (so far as botanical characteristics show) as examples of the highest-grade Gujarat staple. Some of those, for example, collected during Livingstone's Zambesi Expedition at Tette and named *Tonje Kaja* (n. 283), are of this nature. Of that plant Livingstone wrote: 'The *tonje cadja*, or indigenous cotton, is of shorter staple, and feels in the hand like wool. This kind has to be planted every season in the highlands; yet, because it makes stronger cloth, many of the people prefer it to the foreign cotton.' ('The Zambesi and its Tributaries,' p. 111). Lastly, a specimen, n. 646, from Upper Egypt in J. Gay's herbarium (by the label identified as *G. herbaceum β. frutescens, Delile,* '*Fl. Egypt Illust.*') is closely allied to the Indian plant.

Eastern.

Western.

I have not been able to see a sufficiently extensive series of botanical specimens from Africa, nor to discover accounts published by travellers that contain the details essential to enable me to furnish a statement of the African cultivation, and races of plants grown, that could be comparable with that given for India. In a further page, under *G. punctatum* (p. 177), it will be seen I have reviewed a very valuable paper on the 'Cotton Cultivation of Senegambia,' and in doing so have suggested that one of the cottons there mentioned may be the present plant.

There are, however, one or two facts regarding the African cottons that stand out clearly, and which are worthy of being stated even at the risk of repetition :—

No. 23. GOSSYPIUM OBTUSIFOLIUM, *ROXB.*, VAR. AFRICANA, *WATT.*

(A) Specimen collected by Dr. Irving n. 2 (Akese) Abbeokuta, approximately half natural size ; (B) specimen collected by Mrs. E. J. Lugard (n. 198) in the Kwebe Hills, Ngamiland ; (C) portion of (B), life size. A small piece of white paper (x) has been placed below a bractlet occasionally present.

1. *G. herbaceum* proper does not occur in Africa, though it may have been introduced into Egypt several centuries ago. African cottons.

2. The chief cultivated indigenous plants met with along the entire eastern side of Africa constitute a perfectly parallel series to those of India, and are derived mainly from *G. obtusifolium* and *G. Nanking*.

3. On the western side a much more varied assortment is met with, the most characteristic being *G. punctatum*, which has, indeed, been there repeatedly found as a wild plant. The series on the west, especially near the coast, has, it may be said, a closer approximation to the cottons of America than to those of the eastern tracts of Africa, although certain forms of *G. obtusifolium* are found in both the eastern and western areas.

4. *G. arboreum* exists in a greater state of cultivation in Africa than even in India. The forms of that species seen on the eastern side correspond with those of Arabia and India (viz. typical *G. arboreum* and the herbaceous *var. neglecta*), while on the western side there occurs mainly the special variety *G. sanguineum, Hasskl.* But the forms of *G. arboreum* extend all over Africa and are by no means so much restricted to the eastern and western divisions as are *G. obtusifolium* and *G. punctatum*.

From these considerations there would seem no doubt that greater success may be looked for in the cultivation of the special modern races of America, if tried on certain portions of the western than of the eastern tracts. So also, if India has to look to Africa for useful new races, the effort to procure these might, in the first instance at all events, be directed toward the plants grown on the eastern side of that continent; and conversely, if Africa desires to improve by fresh stock, the Indian races might be experimented with on the eastern regions in the first instance, rather than on the western. But to these general statements, drawn from botanical experience, it may be added that greater success with Egyptian cottons may be looked for on the eastern than the western side of Africa. Indication of future cultivation.

25. **G. HERBACEUM**, *Linn., Sp. Pl., 1st ed.* (1753), II., 693, (*in part*); *Ruellius, De Nat. Stirp.* (1537), *Bk.* II., *ch.* 150, 463; *Fuchsius, Pl. Hist.* (1549), *ch.* 221, *also Hist. Stirp.* (1542), *p. and t.* 580–1; *Matthiolus, New Kreüterb.* (1563), 132 *and t.*; *Lobel, Stirp. Hist. et Adv.* (1576), 370 *and t.*; *G. FRUTESCENS, C. Bauhin, Pinax, Thet. Bot.* (1623), 430; *G. HERBACEUM, J. Bauhin, Hist. Pl.* (1648), I., 343–5; *Jonston, Dendrog.* II., *Arb. Nucif.* (1662), 132;

Pomet, Hist. Drug., 1694 (*Eng. transl.*, 1712), I., 153–4, *t.* 54, *f.* 50; *Volkamer, Fl. Norib.* (1700), 195 (*in part*); *Boerhaave, Index Pl. Hort. Acad. Lugd-Batav.* (1720), 2, *Pt.* I., 73–4; *Philip Miller, Gard. Dict.*, 1*st ed.* (1731), *No.* 1; *Linnæus, Hort. Cliff.* (1737), 350 (*excluding synn. of Sloane and Marcgraf*); *Linn., Hort. Ups.* (1748), 203 (*in part*); *Linn., Sp. Pl.* 2*nd* (1763) *and* 3*rd ed.* (1764), II., 975, *in part* (*exclude Rumphius*); *Murray, J. A., Prod. Stirp. Gott.* (1770), 170; *G. ARBOREUM, Forsk., Fl. Ægypt.-Arab.* (1775), 125; *G. HERBACEUM, Lamarck, Encycl.* (1786), II., 133, *No.* 1; *Cavanilles, Diss.* (1785–90), 310, *t.* 164, *f.* 2 (*not good, too hairy, and resembles more an Indian or African cultivated cotton*); *Linn., Sp. Pl.*, 4*th ed., by Willd.* (1800), 803 (*except synn. under Hort. Cliff. and Hort. Ups.*); *Poiret, Dict. des Scien. Nat.* (1818), *vol.* XI., 37–60; *De Candolle, Prod.* (1824), I., 456 (*excl. syn. Roxb.*); *Zenker and Schenk., Waarenk.*, II. (1832), 53–67; *Spach, Hist. Nat. Veg.*, III. (1834), 388; *Tenore, Royal Asiatic Soc.*, 1839, p. 98; *Torrey and Gray, Fl. N. Am.* (1838–40), 230; *Darlington, Agri. Bot., Philadelphia* (1847), 17; *G.? PUNCTATUM, Richard, Tent. Fl. Abyss.*, I. (1847), 63; *De Candolle, Bot. Geogr.* (1855), II., 971–2; *Parlatore, Sp. dei Cot.* (1866) (*in part*), 31–36, *t.* II.; *also Flora Italiana* (1872), V., 20; *Schlosser and Vukotinovic, Florœ Croaticæ* (1857), 180; *Todaro, Relaz. Cult. dei Cot.* 131–40, *t.* IV., *ff. a, b, and c*; *Heuzé, Le Pl. Ind.* I. (1893), 142; *Engler and Prantl, Pflanzwnf.* III., *n.* 6 (1895), 51, *f.* 22 (*after Parl.*); *Aliotta, Rev. Crit. Gen. Goss.* (1903) (*in part*), 66–75.

Levant cotton.

Syrian, Levant, Maltese, Arabian, and some of the short-staple North American cottons. Is the *Goza* of Afghanistan and Khorasan.

Description.

Herbaceous annual, sparsely hairy, and often becoming glabrous, or nearly so, with maturity. Leaves leathery, and prominently reticulate, deeply cordate, less than half-cut into 5–7 broad ovate-rotund, suddenly acute, or apiculate (ogee-shaped) lobes, below distinctly pilose, especially along the veins, the central of which runs through the others into the petiole, and bears midway a distinct gland below (f.2). Bracteoles large, green-coloured, broadly ovate-rotund, obtuse, only very slightly united at the bottom, but profoundly cordate, gashed across the top into 7 to 9 fairly long teeth. Flowers not very large, yellow, with purple claws, and rotating to right; calyx large, loose, undulate, and

No. 24. GOSSYPIUM HERBACEUM, *LINN.*

(A) Type of species in Linn. Herb. Lond. named by Linnæus '1. *herbaceum*' and the letters H. U. (Hortus Upsl.); (B) type specimen of Hort. Cliff. preserved in B. M.; (C) specimen in Linn. Herb. named by himself as '*barbadense*?': see remarks, Plate No. 19.

with large glands (f. 3). Capsule 4–5-valved. Seeds large, angled, beaked, coated with grey fuzz and harsh greyish-white wool. **(See Plates Nos. 24 and 25.**

Description.

Linnæus' description, '*foliis quinquelobis, caule herbaceo lævis,*' is applicable to this species, of course, but equally so to a great many other widely different plants. The species as accepted above might be more fully described as follows :—A small bush often not more than one to two feet in height, stems and branches round, faintly striated, bent slightly at the joints, reddish brown, minutely warted, sparsely hairy, with long, shaggy, white hairs, and, below these, short stellate pubescence, becoming glabrous, or nearly so, with maturity. *Leaves* ovate, almost sub-reniform in outline, deeply cordate, auriculate, and expanding into the petiole ; texture compact, leathery, smooth, thin, drying in the herbarium into a pale yellow-green, 5- to 7-lobed ; lobes nearly as broad as long, ovate or almost rotund, nearly glabrous above, or only very minutely stellately pilose, below distinctly pilose, especially along the veins and margins ; veins very prominent below, almost winged, and thus forming a web-footed structure, which is pink-coloured and semi-glandular, just within the prolongation of the blade into the petiole ; petiole very long, and, like the peduncles, round, dark red, with a few spreading silky hairs ; stipules on the stem awl-shaped, one-nerved, on the peduncles larger, one much broader than the other, toothed, and 3–5-nerved. *Inflorescence* lateral shoots that usually bear at most two flowers, often not half the length of the petioles, at other times even longer ; *pedicels* very short, usually shorter than the bracteoles. *Flowers* hardly twice the bracteoles, hairy on the outside, especially near the tube. *Calyx* large, loose around the ovary, undulate, or with short rounded teeth, many-veined, gland-dotted, glabrous, with bracteoles adherent near the bottom of the tube. *Fruit* ovoid, beaked, deeply gland-pitted, 4-celled.

Herbaceous cotton.

Habitat.—Probably indigenous to North Arabia and Asia Minor (and possibly also Upper Egypt and Abyssinia). Not known to exist as a wild species anywhere, but in cultivation is distinctly accidental. It occurs in the Mediterranean regions (Spain, Sicily, Malta, Greece, Crete, Cyprus, Algiers, Turkey), in Syria, Mesopotamia, Armenia, Persia, Afghanistan, Beluchistan, the North-West Frontier Province of India, and the Northern portions of the cotton area of the United States of America. Poiret speaks of it as the 'herbaceous cotton of Malta,' and thinks that it originated in Upper Egypt. This view is also held by Rawlinson ('Hist. Ancient Egypt,' I. 1881, p. 63), and by Joret ('Les Pl. dans L'Antiq. et au Moyen Age.,' 1897, pp. 43–44). Joret in fact accepts Virgil, Pliny and Pollux as establishing that fact. The passage in Virgil is a poetic imagery, and the authority of the other authors would seem to rest on interpolations on their original text made centuries later than their dates. (Cf. Yates, 'Text. Anti. App.,' pp. 467–72.) If I am correct

Egypt.

Arabia.

in accepting *G. punctatum* of Richard as being this plant, however it would then appear to be indigenous to Abyssinia, since it has there distinctive vernacular names, such as *hont*. Forskal collected it in Arabia. It may, in fact, be described as a warm temperate species and the plant which formerly yielded much of the so-called 'short-staple American cotton' of commerce.

Specimens.

Citation of Specimens.—The following record of some of the specimens seen by me in Herbaria may be usefully mentioned in this place:—EUROPE: Linnean Herb. No. 1 (**Plate No. 24 A**); Clifford Herb. (**Plate No. 24 B**), two sheets (now in British Museum); Herb. Philip Miller (in Sloane Herb., vol. 294, f. 45); Greece, hort. Benth. (1836); Greece (Berger), ex J. Gay (1868); Athens, cult. herb. de Heldreich (1848); Griechenland, Hohenack, Arzn. u. Handelspfl., n. 288; herb. Shuttleworth, cult. Algiers and Asia Minor; Dardanelles, Ascherson (1883), n. 948; Crete, Dr. A. Baldacci, n. 230; Cephalonia, collected by Schimper and Wiest (1834) (and named *G. indicum, Lam.*); Haussknecht, cult. Syria (1868). CHINA AND JAPAN: none. MALAYA: none. AUSTRALIA: none. INDIA: Aitchison, Delim. Com. Afghanistan (Khorasan, n. 1034, stems and leaves dry into the usual pale colour, but leaf-stalks and flowers are apparently purple with maturity); Gilgit (1827), herb. Winterbottom, n. 981, same as next (seed very large, coarse, and floss very woolly and inferior); Gilgit, Giles (1886), n. 250, at 4,600 feet (has the long spreading hairs of the species very abundant). PERSIA: Armenia and Northern Persia, in Ball, herb. (now in Edinburgh); in Herb. Petropolitani (Armenia and Persia), also Dr. Stapf's specimen (these possibly represent a form that may be taken as a hybrid between *G. Nanking* and *G. herbaceum*; the leaves are mostly 3-lobed and have 3 glands). AFRICA: No specimens that could be called typical (just as in India, so in Africa, a good many cultivated plants approximate to this type from *G. Nanking*). AMERICA: none of *G. herbaceum* in Kew and British Museum Herbaria (the plant grown in the States under this name has much larger leaves, and is more hairy than the type, and is apparently a cross between the true Levantine plant and *G. hirsutum*. It is the plant that is so admirably figured by Parlatore under the name *G. herbaceum*).'

It will thus be seen that outside the tract of country that stretches from the shores of the Mediterranean to Afghanistan, the plant to which I think the name *G. herbaceum* must be restricted does not occur.

European cultivation.

Nomenclature.—There is every reason for believing that this was the species first cultivated in Europe. The earliest records would seem to point to a production near Crimea, but the conquests of the Saracens led to its introduction into Spain, in the twelfth century (cf. Eben-el-Awan of Seville), and from there it extended to Italy (cf. 'Targioni-Tozzetti,' translated by Bentham in *Jour. Hort. Soc. London*, IX. (1855), p. 149). Whether it was grown in Greece at a still earlier period seems uncertain, but with the conquest of Constantinople its cultivation was greatly increased and diffused

M. Smith delt, J. N. Fitch lith.

West, Newman imp.

No. 25. GOSSYPIUM HERBACEUM, *LINN.*

1, Flowering branch; 2, portion of leaf showing veins and gland; 3, bud with calyx and glands; 4, fruit; 5, seed with its fuzz and floss; 6, seed with floss removed.

into Macedonia. It is for certain the first bushy cultivated annual *Gossypium* or *Xylon* mentioned by botanical writers. Varthema (' Trav. in East,' Hakl.'s ' Voyages,' IV. p. 552), who visited Damascus in 1503, speaks of the abundance of *gossampine* wool at Aman. Further on he remarks that the Muhammadans make hose of the wool. Porta (' Villa,' p. 900), who died in 1515, refers to what is also, no doubt, this species as largely grown in Italy. Ruellius (*l.c.*) remarks that the plant had been brought from Italy but was now (1537) being grown in France. Fuchsius (Leonard Fousch) speaks of it as grown in Upper Egypt, toward Arabia, in Crete, Malta, &c., and as being recently planted in German gardens. Jonston (*l.c.* 1662) calls this cotton *G. frutescens* (a name also employed by both Bauhins), and gives details of the methods and seasons of cultivation in Crete, Lemnos, Sicily, Malta, &c. It was sown in March to May, and harvested in September and October. Heuzé (' Le Pl. Indust., I. (1893), p. 133) says that according to De Quiqueron de Beaujeu (' De Laudibus Provinciæ,' printed in 1539) they sometimes cultivated cotton in Provence. But this is not, however, exactly true, since Abul Jouan has recounted in 1566 that cotton grew in the gardens at Hyères, but he does not speak of it as an agricultural product. Heuzé further mentions that, a century later, cotton cultivation was attempted in many centres in France, Switzerland, Austria, &c. He specially mentions the endeavours made by M. Dupoy in the Cantons of the Lower Alps and Lower Pyrenees. At that time the French Government gave a bounty of a franc per kilo for cotton plucked in France, cleaned and ready to be ginned. All these efforts showed that the cultivation of cotton was possible only below 41° N. lat.

First Annual Cotton.

Italy.

France.

Switzerland.

An Arab physician who visited Egypt in 1200 A.D. gives a list of the plants seen by him, but makes no mention of cotton. Prosper Alpinus (1592) speaks of the Egyptians importing cotton for their own use from Syria and Cyprus, but says that, while *G. arboreum* was cultivated in gardens in a very small way, the Syrian plant (*G. herbaceum*) was not grown in Egypt. Pena and Lobel (*l.c.*) observe that cotton, hardly known to our ancestors, has been so immensely increased of late that it is no longer necessary to fetch it from the lands and islands of the Arabs, since it now grows on the shores of the Mediterranean and is conveyed thence to market. Lobel, six years later, adds that he had seen it at Patavia and Venice. Rauwolff (' Hodœp.,' I., 5, 65, 1583), Morison (1699) and others speak of it as extensively cultivated in the Euphrates Valley

Egyptian cultivation.

Palestine cottons.

and also between Jerusalem and Damascus. Camerarius (1611) and Pomet (1694) mention raw cotton as coming from Cyprus, Smyrna, &c., and cotton yarn from Damascus. The Jerusalem cottons were called 'bazac.' The true bazac ought to be white, fine, smooth, the best spun, and most equal. Shaw ('Travels and Observations relating to Barbary and the Levant,' 1757), who gives lists of plants seen by him, and describes the chief industries, makes no mention of cotton. Gerarde ('Herbal,' 1597, also ed. 1636), on the other hand, says the seeds had been brought from Aleppo to London, and germinated, but the plants died, as they could not withstand frost.

Bazac cottons.

First commercial cotton.

It is, perhaps, indicative of the importance of the Levantine cultivation that in 1784 a consignment of cotton from the United States was refused admission into Liverpool on the ground that so large a quantity could not have been produced there. Thus there would seem no doubt that the field plant of the Levant was the first commercial cotton of Europe. Some of the early writers on the cotton cultivation of Europe have already been mentioned. Don Joseph Quer ('Contin. de la Fl. Española' (1784), vi., p. 502–5), gives particulars of the cultivation in Valencia. Baines ('Hist. Cotton Manufactures of Great Britain,' 1835) will be found to afford many useful particulars regarding the early traffic in Levantine cotton.

Carried to United States.

At an early date (1621 A.D.), however, it was carried to the United States (Virginia), and there largely cultivated, some time before the discovery of the other special races (the West Indian more especially) that ultimately drove it into a position of very secondary importance. It was this discovery, in fact, that gave the States their supremacy, and caused the area of production to move to the south and west of these States.

There can, in fact, be no doubt of the extensive cultivation of *G. herbaceum* in the States. Thus, for example, Samuel Wilson, in a description of the province of Carolina addressed to the Earl of Craven in 1682, says: 'Cotton of Smyrna and Cyprus sorts grows well and good; plenty of the seed is sent hither.'

Cotton first manufactured.

From the practical standpoint it is essential, therefore, that a clear conception be obtained of the plant which in all probability was the species that first attracted the attention of European manufacturers. I need make no apology, accordingly, for elaborating and expounding the special restrictions implied by the above citation of publications and specimens. There would seem no doubt Linnæus

made a grave mistake when he combined what, for convenience, I have called the Levantine plant of the early authors, with the Brazilian and Jamaican plants subsequently mentioned or described, and even figured, by Marcgraf, Hernandez, Zanoni, Miller, and others.

Chain cotton.

Somewhere about the closing decades of the sixteenth century, European writers became acquainted with a 'chain' or 'kidney' cotton. It seems, accordingly, to have been supposed that that condition of the seeds was true of all cottons. Lobel (in 1576), for example, thought he improved on the pictures given by Fuchsius and Matthiolus, some thirty years previously, by furnishing a plate of *G. herbaceum* to which he added a kidneyed mass of seven seeds. But neither he nor any other subsequent writer definitely described the Levant plant as having kidneyed seeds, though Parkinson (1640), who, perhaps, had no personal knowledge of the subject, remarked that the seeds are 'in a lump or bunch;' while Vesling (Ed. Prosper Alpinus, 1640), in discussing the cotton found by him near the aqueduct of Cairo, expressly says the seeds are not crowded together but scattered through the wool.

Arabian cultivation.

It is perhaps somewhat curious that Forskal, who gave the plant we now call *G. arboreum, Linn.*, the name *G. rubrum*, should have given *G. herbaceum, Linn.*, the name of *G. arboreum*. His specimens (named in his own handwriting) are in the British Museum, so that there can be no doubt that the reduction of his plants should be as indicated. The interesting point, however, remains that in Arabia, in 1773, he collected a specimen of *G. herbaceum, Linn.*

To the unfortunate amalgamation of the plants of the Levant and America, made by Linnæus in his 'Hortus Cliffortianus' and later on in the 'Hortus Upsaliensis,' is due the citation of America as the habitat of *G. herbaceum*. Since the two plants are absolutely distinct (and perhaps the best known representatives of the groups of cultivated cottons spoken of as the 'Asiatic' and the 'American'), it is imperative that they should be separated. It becomes, therefore, necessary either to reject the name *G. herbaceum* or to restrict its signification to one or other of the plants indicated. *G. herbaceum* denotes a cultivated plant; was the name given by J. Bauhin, when he urged that there were three, not one, species of *Gossypium*; is the name almost universally accepted by modern botanists for the Levantine plant; and moreover, since there are excellent examples of it in the Linnean and Cliffordian Herbaria (named by Linnæus

himself) (see **Plate No. 24**), we are justified in excluding the American, plant and in restricting *G. herbaceum* to what I have called the Levantine species. But Linnæus seems to have had a suspicion of the mistake made, for (in the 'Hort. Ups.') he observes that it was *now* successfully cultivated in Greece.

No specimen in Plukenet's Herb.

In passing it may be remarked that it is somewhat significant that Plukenet, an author in whom Linnæus apparently put much faith, neither possessed a specimen of the plant nor described it in his 'Almagestum' (1696)—a circumstance, like many others, that perhaps points to the European knowledge of a cultivated annual cotton plant being of remarkably recent date.

Lamarck, followed by Cavanilles and Poiret, corrected the Linnean description of the species, omitted America and substituted the Levant, Syria and India as its habitat. Cavanilles urged that Linnæus either described another species under *G. herbaceum* or by a printer's error the leaves had been called eglandular instead of uniglandular. He then adds that this species is distinguished by having five rounded, suddenly pointed, lobes. Willdenow similarly modified the Linnean description, gave the habitat India, Syria and Africa, but retained the citation of the 'Hort. Cliff.' and the errors thereby necessarily involved. Lastly Dr. Roxburgh—one of the most accurate of botanists—described and prepared coloured drawings (reproduced as **Plates Nos. 11 and 12**) of two forms of an Indian plant which he accepted as being *G. herbaceum, Linn.*, but in that opinion he was unquestionably in error for, if any two or more cultivated species of *Gossypium* can be viewed as distinct, *G. herbaceum, Roxb.* (see **Plate No. 10**) is certainly very different from *G. herbaceum, Linn.* (see **Plate No. 24**) and must therefore be separated, and with that separation *G. herbaceum, Linn.*, practically disappears from the list of Indian *Gossypia*.

Confused by Roxburgh.

United States cultivation.

Cultivated Forms.—The forms of this species that are deemed of greatest value are (*a*) those suited to cold countries and (*b*) those in the United States that have been so much hybridised with *G. hirsutum* that they are often accepted as grades of that plant. (Cf. remarks below under *G. hirsutum*.) The large-leaved hairy states of this species require a much warmer climate than the sub-glabrous (and botanically) typical conditions. Some of the more recent writers, such as O. F. Cook ('U. S. Dept. Agri. Bureau of Plant Ind. Bull. No. 88, p. 8, 1906') would appear, however, to go to an unnecessary extreme when they affirm that 'The Upland type of cotton

was recognised as a distinct species by Linnæus under the name *G. hirsutum*, but many subsequent writers have erroneously confused the Old World species *G. herbaceum* which is not cultivated in the United States, though often so reported.' It certainly was very largely cultivated prior to 1732 and for many years after was the Upland cotton of the States, and I believe still survives, though mostly in a state of hybridisation with *G. hirsutum*.

It has been stated that in the United States of America this plant, under most favourable cultivation, produced seed-cotton, the cleaned lint of which was only 25 per cent. of its weight and had a staple only 20 to 30 mm. in length.

SECTION III.—Fuzzy-seeded Cottons with Free Bracteoles.

Bracteoles *quite free below* (*very rarely slightly united and mostly as a consequence of hybridisation*); Peduncles *thickened upwards and often bearing fairly conspicuous external and internal glands*; Seeds *large with a distinct and mostly complete fuzz, also a firmly adherent floss*; Leaves *generally large* 3–7 *palmatifid, pilose, rarely tomentose or still more rarely glabrous.*

American (and in one case African) species, but none of them Asiatic. A fair percentage exists as undoubted wild forms, and the chief cultivated species—the green-seeded cotton—manifests a close association with British colonists. Collectively they constitute a parallel assortment with the Asiatic cottons, placed under Section II. The species of both sections have fuzzy seeds, but in the present assemblage the leaves are large, broad, and mostly segmented on the upper half of the blade only, while the bracteoles are free or nearly so, hence the diagnostic description of fuzzy-seeded cottons with free bracteoles.

Analytical Key to the Species.

* *Leaves broad, pilose-tomentose, one half segmented on the apex into* 3 (*imperfectly and only occasionally* 5) *ascending lobes, lobes broad triangular, petals mostly with purple claws.*

† Leaves thick, granularly tomentose; bracteoles with long linear ciliate teeth; capsule 3-celled
26. **G. mustelinum** . . . . (p. 167).

†2 Leaves villous, especially below often conspicuously punctate; bracteoles with the teeth fimbriately

villous; capsule mostly 3-celled; seeds large with grey or rust coloured fuzz
27. **G. punctatum** . . . . (p. 168).

†3 Shoots rigid, erect; leaves coarse, brownish green, hirsute, and dust-coated; capsule usually 4-celled; seeds large, when fresh with greenish fuzz . . 28. **G. hirsutum** . . . . (p. 183).

†4 Shoots slender trailing or climbing; leaves profusely pilose-tomentose; bracteoles relatively large and deeply gashed; capsule 4-celled; fuzz (and often floss also) rust-coloured
29. **G. h. v. religiosa** . . . (p. 201).

** *Leaves tomentose or glabrescent entire or deeply segmented (three-fourths of the diameter or more) into 3–5 linear oblong lobes, which are generally constricted below and much narrower than long, petals in most species devoid of purple claws.*

† Leaves glabrescent, linear, and pinnately veined or deeply three-segmented; flowers very small; fuzz green; stipules large, caducous, scars prominent
30. **G. Palmerii** . . . . (p. 204).

†2 Leaves glabrous, otherwise as above
31. **G. fruticulosum** . . . (p. 206).

†3 Leaves pilose, almost split into 3–5 linear cuneate lobes, base hardly cordate; petiole about equal in length to the blade; flowers fairly large; fuzz rust-coloured; stipules and scars not conspicuous . 32. **G. Schottii** . . . . (p. 206).

†4 Leaves pilose, entire, lanceolate; petiole very long
33. **G. lanceolatum** . . . . (p. 210).

†5 Leaves pilose, ciliate, deeply cordate, split into 5, more rarely 3, linear lobes with prominent midribs; flowers large, petals thick, tomentose; calyx very large, teeth prominent; capsule 3-celled; seeds semi-conglomerated; fuzz partial, often green
34. **G. microcarpum** . . . (p. 210).

†6 Leaves large, broad, when young tomentose below, half or three-quarters segmented into oblong mucronate lobes; flowers very large, petals usually tomentose and drying into a greenish yellow tint;

calyx obscurely toothed; fruit 3-celled; seeds large, free, and with a distinct though often only partially formed fuzz, green, grey or rust-coloured, and wool copious and silky

35. **G. peruvianum** . . . . (p. 213).

*** *Leaves very broad, quite glabrous (except when young or on the veins) segmented for hardly more than one-third the diameter into 3-7 radiating lobes (the lower pair often teeth rather than lobes), lobes triangular, much broader than long.*

† Flowers small on short pedicels; capsule mostly 5-celled; seeds with a complete or partial fuzz

36. **G. mexicanum** . . . . (p. 226).

Demarcation of fuzzy-seeded cottons.

In another place I have characterised *G. punctatum* as demarcating the fuzzy-seeded cottons (see p. 44). On the one hand there is the well-marked group formerly called by writers on this subject the 'Asiatic Cottons,' (pp. 77–213) and on the other an assemblage of fuzzy seeded cottons confined to Central and South America (pp. 204–13). This I venture to think is more than a coincidence. By American cottons are generally understood *G. barbadense, G. brasiliense, &c.* Down to the past decade or so *G. hirsutum* was classed as a variety if not a synonym for *G. herbaceum.* It was accordingly treated as an Asiatic species. Major Trevor Clarke, it will be seen (p. 190), advanced the opinion that while the Asiatic cottons could be freely crossed and hybridised among themselves; and while the American series could be similarly interbred among *themselves*, the two sets, Asiatic and American, could not be crossed. But if *G. punctatum* and its great cultivated manifestation *G. hirsutum*, are American in origin, then the impossibility of crossing the Asiatic and American sets of cottons instantly disappears. The connecting link, the means of bridging over the difficulty hitherto experienced, exists in the American fuzzy-seeded cottons. Numerous investigators have reported the production of crosses between *G. hirsutum* and *G. herbaceum* or *G. obtusifolium.* In fact, Major Trevor Clarke himself furnished a hybrid of that very nature to the Indian Cotton Commissioner.

Crossing American and Asiatic cottons.

But *G. punctatum, var. jamaica* is not the only fuzzy-seeded cotton in America, and to this fact I attribute one of the advantages to be gained by my classification, viz. the definite recognition of the American fuzzy-seeded cottons. (See p. 336.) They have been too long neglected and their possible value lost sight of by the practical cotton-grower.

There seems to my mind little or no doubt that *G. microcarpum* and *G. peruvianum* are crosses traceable to the fuzzy-seeded cottons of Central and South America as one of their parents. The close association of the last-mentioned plant (*G. peruvianum*) with Africa and Egypt is at first sight difficult of comprehension. But when it is recollected that an exceedingly plentiful wild and cultivated species (a member of the so-called American fuzzy-seeded cottons) has been known in Africa and Upper Egypt from the most ancient times, viz. *G. punctatum, var. nigeria*, then the difficulty, I think, disappears. It is thus quite possible that the various states of *G. punctatum* were crossed with *G. barbadense*, *G. vitifolium*, or *G. brasiliense*, and thus originated special races, as, for example, the so-called *G. peruvianum*, but a cross of that nature might as easily have occurred in Africa as in Peru. In part support of this opinion, mention may be made of the fact that while repeated efforts have been put forth to acclimatise Sea Island cotton in Egypt, the results have not been so satisfactory as the endeavours (at present engaging the attention of the Egyptian authorities) to improve the so-called Egyptian cottons, the *mit afifi, abassi, &c.* These are races of *G. peruvianum*, as accepted by botanists, which might be designated indigenous to Egypt, and are therefore the most hopeful stocks for selection and improvement. The recognised trade differences between South American cotton of this type and Egyptian cotton, may be due, of course, to climate and soil, but there is just the possibility that they are the direct expression of the fact that in the one the fuzzy-seeded ancestor has been *var. nigeria*, and in the other *var. jamaica*. By way of concluding these observations on *G. peruvianum* attention may be drawn to the circumstance that Sloane's specimens of *G. brazilianum* preserved in the British Museum turn out to be *G. peruvianum* and not *G. brasiliense*. This is certainly most curious, and it shows that the plant here dealt with has been known for several centuries.

Egyptian cottons.

So again there would seem every reason to anticipate that *G. microcarpum* may be established as a hybrid from *G. Schottii* (or some other allied species) crossed with *G. brasiliense*. The tree cotton, brought by M. Jumel to lower Egypt in 1822, was, I believe, *G. brasiliense*, a plant long acclimatised in upper Egypt and Africa, as, for example, at Nyam-Nyam in the Soudan. It is thus highly likely that the repeated appearance in Egypt and Africa of plants that must be classed as *G. microcarpum* may be the direct consequence of the spontaneous crossing of some indigenous stock (such as *var.*

Jumel's cotton.

M. Smith delt, J. N. Fitch lith. West, Newman imp.

No. 26. GOSSYPIUM MUSTELINUM, *MIERS MS. in B. M.*

1, Portion of flowering branch; 2, young fruit, showing calyx with conspicuous dots but devoid of glands; 3, portion of leaf showing minute granular pubescence; 4, young fruit; 5, seed with fuzz and floss; 6, seed with floss removed.

nigeria with *G. brasiliense*) rather than the importation and acclimatisation of *G. microcarpum* from South America. It is certainly remarkable that in India, where *G. brasiliense* is often found in a state of complete naturalisation, there are no instances of *G. peruvianum* and *G. microcarpum* occurring under such conditions as to justify the belief that they are locally produced, still less indigenous stocks. In India there are no acclimatised fuzzy-seeded American cottons (such as in Africa and Egypt), and to this circumstance, therefore, I venture to think we are justified in believing is due the appearance of the *abassi* and other special cottons of Egypt.

Upland cottons

But the discussion of the Egyptian cottons by no means exhausts the story of the influence of the American fuzzy-seeded stocks, for to this same category has to be assigned the Uplands. I conjecture, in other words, that the multitude of modern Uplands have been produced by crossing *G. hirsutum* with some Mexican plant. No person, however, seems, to have discovered the plant, to which Todaro gave the botanical name *G. mexicanum*, in a wild or even acclimatised condition. It got the name *mexicanum* because it was presumed to have come from Mexico, but it existed there purely and simply as a cultivated plant. There would, in fact, appear to be two great types, one with broad almost glabrous leaves which are hardly more than angled (**Plate No. 41**), the other with softly hairy leaves, distinctly five-lobed (**Plate No. 42**). The former may have been produced by crossing *G. punctatum, var. jamaica*, with *G. purpurascens*, and the latter by crossing *var. jamaica* with *G. vitifolium*. And I have noted that variation in the former seems generally to be toward glabrous leaves and naked seeds, and in the latter toward more pilose states and naked seeds. The dominant ancestor would, therefore, be the fuzzy-seeded *G. punctatum* (or *G. hirsutum*), and the recessive parent *G. purpurascens* in the one and *G. vitifolium* in the other, both of which have naked seeds.

Conclusion

It would of course be unwise to place too much dependence on observations based on herbarium studies, hence all I desire to emphasise by the foregoing remarks is the existence of the American fuzzy-seeded cottons that are perfectly distinct from the fuzzy cottons of Asia.

26. G. MUSTELINUM, *Miers MS. in British Museum.*

A wild species, only once or twice separately collected hitherto. Leaves broad, deeply 3-lobed, thick granularly pubescent (**f. 3**);

bracteoles, with many long, linear, ciliate teeth; seeds six in the cells, large and coarse, with both fuzz and floss, rust-coloured. **(See Plate, No. 26).**

Description. Bushy perennial, with the branches stout woody, the twigs 3-furrowed, twisted and, like the leaves, covered with short, adpressed, hoary, granular pubescence. *Leaves* (recalling *Jatropha Curcas*) very thick in texture, deeply cordate, 3-lobed, 3½ inches long, to tip of central lobe, by 4 to 5 inches in diameter from tip to tip of the lateral lobes; lobes approximately ovate, acute mucronate, and margins ciliate; centre lobe ovate-oblong acuminate, up to 2 inches in breadth at the base; when young densely matted with stellate, often clustered hairs, the upper surface (except the veins) becoming sub-glabrous, and drying into a deep brown colour in the herbarium, and indistinctly black-dotted; sinus sometimes thrown up in a fold; glands one or more irregular slits rather than definite glands; stipules large, erect, caducous; petiole rounded, densely tomentose, and half shorter than the blade. *Inflorescence* long, many-flowered shoots, the first joint being at least twice the length of the petioles; pedicels shorter than the petioles, erect, densely tomentose, with black gland dots; *bracteoles* ovate oblong, free, deeply (almost tail-) toothed throughout, the lowest pair more or less thrown across the cordature; glands on the apex of the pedicles obscure or absent. *Flowers* longer than the bracteoles, petals pilose, yellow tinged with purple; *calyx* loose campanulate, nearly glabrous ciliate on the margin, many-veined, cut square across, and possessed of small but distinct glands. Young *fruit* not much elongated, but considerably beaked, and composed of three tapering walls prominently reticulated, 3-celled; *seeds* six in each cell, 2-seriate, coarsely formed, fuzz copious and like the wool, rufous-coloured; wool not abundant, soft, silky.

Brazil. *Habitat.*—Brazil (Crato, Ceara), and Colombia.

Citation of Specimens.—There are excellent samples of this plant in the British Museum, in the Kew and Cambridge University Herbaria, all collected at Ceara, Brazil, by Gardner, in 1838, n. 1,463, and stated by him to have been found in the woods; it recalls very forcibly *G. tomentosum*. A second specimen of what I take to be this plant was collected by J. F. Hutton in April 1853, n. 749, in Colombia ('Flora Neogranadina—Caucana (La Paila)').

27. **G. PUNCTATUM, *Sch. et Thon.*,** *Beskr. Guin. Pl.*(1827), *p.* 309–10; *Curaçao Cotton, Rohr, Obs. sur la Cult. du Cot.* 1807, *pp.* 47–50; *Columbia Island Cotton, Koster, Travels in Brazil*, 1816, *p.* 368, *footnote*; *G. PUNCTATUM, Guillemin, Perrottet and Richard, Fl. Senegamb.* I. (1830), *pp.* 62–63; *G. JAMAICENSE, Macf., Fl. Jam.* (1837) I. 73; *G. PUNCTATUM, Leper. et Perr., Samuel Brunner, Ergebnisse, Senegambia Botan. Zeitung*, 1840, I., *pt.* 2, *p.* 75; *G. BARBADENSE, Hook and Arn., in Fl. Beechey's Voy. (Mexico* 1837), *published* 1841, *p.* 411; *G. NIGRUM, VAR. PUNC-*

No. 27. GOSSYPIUM PUNCTATUM, *SCH. ET THON.*

(A) Var. nigeria, *Watt*: the wild cotton of Badagry; (B) var. jamaica, *Watt*: the wild cotton of the West Indies and the shores of the Gulf of Mexico.

TATUM, *Hooker and Webb, Pl. Cape de Verd Islands in Niger Flora*, 1849, *p.* 107; *G. BARBADENSE*, *Hook. et Benth., Flora Nigritiana in Niger Fl. p.* 229; *G. BARBADENSE* (*in part*) *Oliver, Fl. Trop. Af.* 1868, *vol.* I. *p.* 210; *G. PUNCTATUM*, *Tod., Rel. dei Cult. Cot. p.* 198; *G. CAESPITOSUM*, *Tod., l.c. p.* 201; *G. RHORII* (*Rohrii*) *Tod., p.* 242; *G. JAMAICENSE*, *Tod.*, 237; *G. PUNCTATUM*, *Welwitsch, Cat. Af. Pl.* 1896, *pt.* I., *by Hiern, p.* 78 (*in part*), *also G. MARITIMUM*, *Hiern, l.c.* 78, *in part*; *G. PUNCTATUM*, *Henry, in L'Agri. Pratique des pays chauds, vol.* III. *pp.* 46, 187, 308, 441, 596, 718; *vol.* IV. *pp.* 80, 235.

Cultivated forms.

A wild (or at least acclimatised and ferine) cotton, from which very possibly has been developed *G. hirsutum* (or many of the short staple cottons of the United States, &c.). It is the wild cotton of Alabama, Costa Rica, Jamaica, Curaçao, as also of Senegal, Nigeria, Angola, &c. Is also the *Moqui* cotton of Arizona, and the *Hindi Weed* of Egypt. It occasionally exists as a cultivated plant (e.g. the *Molango*, the *Texas Wool*, *King's Improved*, *&c.* of the United States, and the *N'Dargua* of Senegambia), but it forms in that case an assemblage of stocks which as a rule are of lower value than the parallel series placed under *G. hirsutum*, though they are often specially suited to the countries and conditions of their cultivation.

Description.

Shoots, young leaves and bracteoles stellately villous, the hairs usually long and spreading, but becoming less abundant on maturity, conspicuously punctate (**No. 28, A 2**); leaves, upper, ovate cordate, entire, slightly longer than broad, 3- or imperfectly 5-nerved, middle nerve only with a large excavated gland below (**A 2**), lower leaves one-third segmented on the extremity into 3 (sometimes only 2, more rarely 5) ovate deltoid acuminate lobes; bracteoles ovate acute auricled, teeth fimbriately villous; calyx large, loose, truncate, entire, crenulate, or with 5 to 10 often large triangular, irregular, or even tailed teeth (**A 3 and B 1**), more or less ciliate on the margin, otherwise glabrous; fruit ovate, suddenly and sharply beaked, mostly 3-celled (**A 4**); seeds large, irregular, coarsely coated with rusty-coloured fuzz (or under velvet) and a liberal layer of soft silky floss. **(See Plates Nos. 27 and 28).**

A woody shrub, twigs quite round, with long, spreading hairs, often tufted and stellate. *Leaves* pubescent above, villous below, $1\frac{1}{2}$ to 3 inches by 1 to $2\frac{1}{2}$ inches, those on the flowering shoots $\frac{1}{2}$ to $\frac{3}{4}$ inch long, mostly 3-lobed, lobes not constricted below, veins 3–5 thick flat, the middle one only with a long coarse gland near the base; *petiole* prominently gland-

Description.

warted, and with tufted stellate hairs at the extremity within the cordate base of the leaf, this degree of hairiness often existing when the plant is otherwise almost quite glabrous; *stipules* oblong to linear-lanceolate, caducous; leaves often arranged as it were in two rows, with solitary ascending peduncles. *Inflorescence* on short lateral extra-axillary shoots, for the most part bearing only one leaf and one flower, the former sometimes falling early, thus leaving the flower to appear as if borne on a long jointed peduncle, the upper third—the actual peduncle—3-gonal warted, shaggy, through masses of stellate hairs, thickened upwards into a glandular-like swelling within the involucre auricles; *bracteoles* 3 ovate acute, almost quite free, deeply auricled, 9–11 toothed, ciliately villous on both sides, becoming accrescent on the fruit and membranous. *Flowers* medium sized, wide, from a very short tube, yellow, with small, irregular, purple spots and pink tinge on the tips of the petals as the flowers age; *corolla* with outer surface tomentose, margins of the claws ciliate, and rotating to left; *calyx* campanulate, 5-angled or toothed, many-veined, glabrous, prominently black gland-dotted, ruptured in the fruit, having 3 glands at the base which become most distinct in the fruiting stage. *Fruit* ovate, oblong, glabrous, style much protruding and causing the fruit to become beaked, 3–4-celled, cells 3–8 seeded; *seeds* free from each other, remarkably large, and distinctly possessed of both a fuzz and a floss, which firmly adhere to the seed, the former often rusty-coloured, the latter pure white and silky.

Distinctive Forms.

There are two forms of this plant—(a) *var. jamaica*, the American and West Indian, and (b) *var. nigeria*, the African. The former (= *G. jamaicense*, *Macf.* **Plates Nos. 27 and 28 B**) is subglabrous, the leaves more deeply lobed, and the calyx teeth triangular to crenate, and the seeds small, irregular, with rust-coloured fuzz and small quantity of dirty-white, woolly floss; the latter (*G. punctatum*, *Sch. et Thon.* **Plates Nos. 27 and 28 A**) is often pilose, the leaves ovate cordate, acuminate, entire or shortly 3-lobed, the calyx teeth tailed, the seeds large, with white fuzz and wool fairly abundant.

America and Africa.

Habitat.—East Coast tracts of America from Alabama to Costa Rica, including Jamaica and Curaçao Islands, and westward to Arizona; also the West coast of Africa, from Senegal to Angola, and inland to Central Africa and the borders of Upper Egypt and of East Africa.

Specimens.

Citation of Specimens.—According to Macfadyen, *G. jamaicense* is 'the Wild Cotton' of Rockfort (Jamaica), but, curiously enough, no sample of it from that locality exists in the Kew, British Museum, or Edinburgh Herbaria; but there is a plant with huge fruits and immense seeds, collected by C. Wright at Cuba, that seems to belong to this species. There are, however, several specimens of it in the Herbaria just named: from Key West, Florida (such as Rugel, n. 93, February 1846, and his '*G. racemosum*, *Poir?*' (n. 92) collected in South Florida, January 1845); that contributed by A. H. Curtiss, nn. 386 A and 5,655 (named *G. uliginosum*, *Linn.*, a name that cannot be traced); also from Alabama (by Drummond 1832 (**see Plate, No. 27 B**); from Mexico (by Pavon in B. M.); and from Costa Rica (by Tonduz, n. 13,484). Dr. E. Palmer collected a cotton (n. 116) in the State of Coahuila (Mexico) (San Lorenzo de Laguna) that is very possibly this

M. Smith delt, J N. Fitch lith.

West, Newman imp.

No. 28. GOSSYPIUM PUNCTATUM, *SCH. et THON.*

A.—1, Flowering branch of var. *nigeria*; 2, portion of leaf showing gland and punctations; 3, calyx with its pointed teeth and prominent glands; 4, ripe fruit; 5, seed with both fuzz and floss. *B.*—1, Calyx of var. *jamaica*; 2, seed with fuzz but much smaller quantity and shorter length of floss than in *A* 5.

plant, though it is too nearly glabrous, and the fuzz on the seed imperfect. The label bears the remark, 'supposed by some to be native.' Another sample of the same plant is Palmer's n. 10 (named *G. barbadense*), 'a cultivated plant four years old, the seed from the Laguna desert cotton country in Coahuila.' Thus Alabama and Florida, in say the 30° N. lat., may be viewed as the one, and Costa Rica, in the 10° S. lat., the other limit of the American distribution of this plant. Specimens.

Crossing the Atlantic to the continent of Africa the species is again met with, both cultivated and wild. In the Edinburgh Herbarium there is a specimen by J. Brown-Lester, n. 59n, collected during the Gambia Boundary Commission, that is a cultivated state of this plant. Specimens came from Badagry in 1825 (see Herb. G. Don. in B. M.); a further specimen from Lagos (district of Badagry), and reported on by W. Higginson as 'the wild cotton' (see Plate, No. 27 A); from Sierra Leone (where Barter found it during the Niger Expedition), said to be 'common near the cliffs'; from Senegal, collected by Brunner, n. 140 (ex Herb. Shuttleworth in B. M.), also by the same, n. 32, cult. in the Island St. Ludovie (a form with small, thick leaves); from the Gold Coast, Mr. W. H. Johnson recently sent to Kew three sheets numbered I., II., and III., all these have been named *G. punctatum*, but only II. should bear that name: III. is *G. hirsutum*, the cultivated state of *G. punctatum*, and I. is *G. peruvianum*. They were all grown at the Anum Cotton Farm.

More recently, Mr. Dudgeon has sent from the Gold Coast a specimen of this plant, which he speaks of as 'native small-bolled, pale-flowered cotton from Labolabo.' A form very near to this species, if not identical with it, comes from far to the South, namely Angola (Welw., n. 5,222, named *G. maritimum*, Tod.). But in addition, n. 5,224 seems typical *G. punctatum* (at least the Kew specimen is so), and of this it is said that it is both cultivated and spontaneous 'but not indigenous near Sange.' In this connection also it may be mentioned that several specimens of this plant have come from Madeira such as Mr. R. F. Lowe's samples. R. Webb collected it, in 1896, at Nyasaland, where it was called *kota-kota* (see B. M.) Lastly, Dr. E. Vogel's n. 35, from Central Africa (*kouku*, collected February 2, 1854) is probably this self-same species, as also, it may be added, is Captain W. H. Wellby's plant, brought from far to the east, near Lake Rudolf (September 1899).

It will thus be seen that the African distribution (so far as at present known) lies chiefly between Senegal, 15° N. lat., and Angola, 15° S. lat. Lastly, in the Kew Herbarium there is a sample of what I take to be this plant, communicated by Dr. Jameson (n. 189) from the Saharanpur Botanic Gardens of North India. Where the seeds were originally obtained from, has not been stated, but it seems to have been there experimentally grown some time before 1861. It possibly is the 'Hindi Weed,' brought from Egypt along with the Egyptian cottons that were largely experimented with in India, or may have come from Mauritius as a half-way house (see below).

In the Edinburgh Herbarium there is an interesting series of specimens of this species, but, curiously enough, these are referable to two sets: the first mostly derived from Jamaica, and *var. jamaica*; the second entirely from India, and exclusively *var. nigeria*. In addition to duplicates of Rugel's nn. 92 and 93, there is a beautiful specimen collected in Jamaica by Dr. McNab. This is apparently a cultivated state, not a wild form. Then

Specimens.

there is an excellent specimen, collected by Dr. J. Brown-Lester (n. 59) during the Gambia Boundary Commission of 1890–91. Turning now to the Indian series, there is a specimen collected by Mr. J. F. Duthie at Gilgit, Kashmir (n. 12,312) during 1892. This was found under cultivation, and known to the people by the name *keas* (Batti). Lastly a plant procured from Dr. Jameson, of the Saharanpur Botanic Gardens, and said by him to be Mauritius cotton.

In the Herbarium of the Royal Botanic Gardens, Calcutta, there are several sheets of this plant. One collected by Sir D. Brandis in Burma, in 1858, is perhaps a hybrid. Had there been no fruits and seeds on the sheet it would very possibly have gone to *G. purpurascens*, as the plant is more glabrescent than is customary; but do the fruits and seeds belong to the flowering twigs? The other examples are all marked H. B. C., and named by Kurz as *G. religiosum*. It is thus highly likely that some thirty or forty years ago the effort was made to grow this plant in the Calcutta Gardens, as also many other species of cotton. (Cf. *G. Nanking*, p. 117, and *G. obtusifolium*, p. 140.)

In the Herbarium of the Reporter on Economic Products to the Government of India there are several examples of this species, but all these are the pilose *var. nigeria*. On two occasions I collected it as a field crop, first at Gondal in February 1894 (n. 1,797). On this occasion the information was given me that the seed had, some years previously, been imported from Louisiana. The second occasion I collected it at Sauner, Nagpur, C. P., in December 1894 (n. 13,819). Though much like *G. hirsutum*, the flowers are yellow with purple spots, the leaves much smaller, and the seeds have an imperfect or very short and striated fuzz. Still a third example (n. 1,749) was sent me in 1894, by Mr. R. P. Mehta, from Bhavnagar Kathiawar Experimental Farm. This was observed to produce bractlets in place of nectaries, and on that account was thought curious. It was said to yield a rufous (*khaki*) coloured floss, hence it may possibly have been a recessive manifestation approximating toward the ancestral type of *G. punctatum* from a stock otherwise *G. hirsutum*, or it may have been procured from the neighbouring State of Gondal, and thus been the Louisiana plant already mentioned. The specimen before me is too fragmentary to enable me to see the bractlets, but these structures had not been described by Cook at the time Mr. Mehta made his observation, and there is thus no occasion to doubt the accuracy of the statement. Mr. Mehta's specimen exactly matches the Molango cotton (see p. 231) grown at Washington.

Wild cotton.

Nomenclature.—The American form of this plant would appear to have been first seen by Rohr, who speaks of it as growing wild on the rocks that surround the harbour of Williamstown, in Curaçao. (Cf. with *G. Nanking*, p. 120). This was in 1790, or nearly fifty years before the time when Macfadyen reported having found it wild at Rockfort in Jamaica.

Jamaica.

One of the earliest allusions to West African cotton, and, therefore, possibly this species is in Ramusio, where, he says, cotton thread and cloth were sold in Nigeria in 1450. John Leo (Giovan

Leone Africanus), who resided in North Africa and Egypt, and explored a large part of the west coast (from 1492 to 1526, see Pory's transl. 1600), repeatedly speaks of the finest cotton coming to the coast towns from the more interior country of the Negros. This same statement, it will presently be shown, was made by Poiret in 1818. It seems safe to assume, therefore, that the fine cotton of these early writers may have been derived from the cultivated states of the present species, seeing that the fine cotton of the interior tracts to-day is mostly obtained from it. Nigeria.

Crossing Africa to the eastern side, the opinions of other travellers are quoted by Pory (*l.c.* pt. I. p. 22), such as Don Francisco Aluarez, who observed 'great plenty of cotton whereof they make cloth of divers colours.' That remark was made of Abyssinia in 1520, and possibly had reference to *G. herbaceum* or *G. arboreum*, not *G. punctatum*, for the simple reason that no authentic specimen of that species has as yet been collected in Abyssinia. The plant named *G. punctatum* by Richard ('Tent. Fl. Abyss.' I., 1847, p. 63) is, I believe, *G. herbaceum*.

The West African plant here described was first definitely recognised botanically by Guillemin and Perrottet, who collected it in Senegambia, and gave it the MS. name which was later on accepted and published by Schumacher, who procured the plant from Guinea. Brunner (*l.c.*) divides the cottons of Senegambia into three groups: (*a*) those cultivated, (*b*) those partially cultivated, and (*c*) those met with quite wild. The wild forms were seen on the hills of Sal where the leaves are more deeply lobed and more completely covered over with dots than is the case with the cultivated states. Winterbottom ('Account of the Natives of Sierra Leone,' 1803, vol. I., p. 95) speaks of a cotton found near the coast growing 'as common, and almost as much neglected, as the thistle in England; it is generally of too short a staple, as it is termed in trade, to be worth exporting.' It is highly probable, moreover, that this is the plant which Mockler-Ferryman speaks of as wild in many parts of West Africa ('West Africa,' 2nd ed., 1900, pp. 439–441). In spite of its inferior staple it is perhaps one of the most interesting of all cottons, and has been recorded as met with in a truly wild condition in several localities, and not a few of the specimens, seen in Herbaria (from the nature of their flosses), would seem to justify that opinion. Others are undoubtedly survivals of cultivation, and may be observed in the series of Senegambia. Wild cotton.

pilose forms to gradually merge into *G. hirsutum, Linn.*, and in the glabrous into *G. mexicanum, Tod.* (Mexican Cotton), if not ultimately into *G. purpurascens, Poir.* (Bourbon Cottons.) Schumacher and Thonning would seem to speak of the seed in their plant as being naked, at all events they observe that it varies into a naked-seeded form. Thus I have supposed these authors to imply that in its normal state it is fuzzy. The glabrous variation to which they allude may, however, have been *G. purpurascens*, and therefore a distinct species. Guillemin and Perrottet have no doubt on this point, as they speak of the fuzz as brown and of the wool snowy white and firmly adhering to the seed.

Fuzzy seed.

The interest in the present species turns on its close connection with at least one of the prized cottons of modern commerce. The truly wild plant is thus available for scientific test experiments on cotton improvement.

Var. prostrata, Watt; *G. prostratum, Schum. et Thon. l.c.* 311. A prostrate shrub, with the leaves simple or 3-, more rarely 5-lobed; *calyx* often with acuminate teeth, and seeds with both a fuzz and floss. I mention this form on the authority of the original authors. I have seen no sample of it, unless one in De Candolle's herbarium, which I prefer to treat as a cultivated plant, but its parallelism with *G. religiosum* as a variety of *G. hirsutum* (below) seems worthy of record. (Cf. Oliver, 'Fl. Trop. Afr.' I. 1868, p. 212.)

Cultivation.

West Africa.

In many parts of West Africa, as already indicated, this plant exists in a state of cultivation that can hardly be described as manifesting a development into *G. hirsutum*. It is there simply cultivated *G. punctatum*. Many writers who deal with the cotton production of West Africa seldom give particulars as to the species met with by them. But the prevalence of the present species justifies the more interesting reports that have appeared on West African cotton being placed under contribution in this position.

Palmerston's prophecy.

Mention has already been made of Lord Palmerston's prophecy that the West Coast of Africa would outstrip all other countries in the production of cotton, excepting only the United States. The realisation of that prophecy is still in the future, and is likely to remain so until the great cotton-growing tracts have been opened out and facilities of quick and cheap transit provided. Many failures will doubtless frustrate temporarily the endeavours of the pioneers, but if local resources and indigenous stocks are taken in hand and

guided forward, a full realisation is not only possible but highly likely to be accomplished. Judging purely and simply from botanical evidence, greater success is likely to be attained in the coast tracts at least, with the acclimatisation of American Uplands and in the more interior and northern tracts, of Egyptians, than with any other foreign stocks. But by far the most hopeful and enduring results should be looked for in the selection and improvement of indigenous races. The establishment of seed farms —a system I recommended for India some years ago—is I believe the immediate step which should be taken. The issue from such farms of improved and acclimatised seed would not only give better results but be open to less risk of failure and disappointment than the issue of untried freshly imported foreign seed, however highly commended by experience in other countries.

Seed farms.

It may now serve the present purpose to set forth some of the opinions and results hitherto attained :—

Results attained.

West Africa.—Long years ago Poiret ('Dict. des Scien. Nat.' 11, 1818, p. 47) wrote : Africa, though it contains large stretches of land very favourable to cotton, furnishes little to commerce. It is found in Barbary, in the Kingdom of Tunis, and in Bildulgérid, but it is not taken sufficient care of, and in consequence is hardly a commercial product. The inhabitants of these countries prefer to clothe themselves from the wool of their flocks. The same is the case in Egypt, where the cotton cultivation is resorted to for domestic purposes only. In the coast towns of Senegal, Sierra Leone and Guinea it is customary to see samples of cotton brought from the interior of the country by the merchants who trade with the negroes. This cotton, although very soft and white, is thought less of by the negroes themselves than the cotton which resembles the yellow Siam cotton found in the Kingdom of Dahomé. I do not know the tree which produces this fine cotton, but it is certain that several species of cotton grow naturally on the coast of Guinea, and that some have been transplanted to the Antilles, where they succeeded very well.'

Negro cotton.

Guinea cotton.

Some of the more recent writers exemplify the development that has since Poiret's time taken place, but they still maintain the separation of the coast tracts as distinct from the more interior regions :—

Mockler-Ferryman (*l.c.*), for example, gives perhaps the fullest account of the cultivation of cotton in West Africa as yet published.

The following passages from his work manifest the chief points of interest in the present connection :

'Cotton grows wild in many parts of West Africa, and is extensively cultivated in some districts, though more for the purpose of supplying local demands than for export. In the latter respect, the trade in this article has proved a disappointment; great hopes were entertained at one time that Manchester would be able to draw largely on West Africa for her supplies, but so far the total annual value of cotton imported into Great Britain from West Africa has never exceeded a few thousand pounds. During the American War the price of cotton became so high that the West Coast merchants saw an opportunity for developing this trade; they accordingly sent out machinery and started operations in many different parts, chiefly in the neighbourhood of the Gold Coast and Lagos. Little, however, came of the enterprise, for with the conclusion of the American War prices fell again, and there was no market for West Africa cotton.'

Lagos cotton.

Gold Coast.

'For the past few years the export of this article even from Lagos and the Gold Coast has been so insignificant that its value has not been separately recorded; while from other parts of British West Africa no considerable amount of cotton has ever been exported.'

'It seems extraordinary that this should be the case, when it is known that it grows freely in every variety of soil and is cultivated with the minimum of labour; but, on the other hand, it must be remembered that the natives are most conservative in their ideas, and prefer making up their own cloth to purchasing ready-made European material. Another point is that West African cotton (as grown in the British possessions) is of an inferior kind, that grown near Lagos being of a brown colour, rough and short.' 'Mr. Scott Elliott says: "The quality is not good, being only about one inch long in staple, and cannot be easily spun over thirty hanks; it is therefore only worth about 5*d*. to 6*d*. a pound in Manchester. The cotton grown in the country is worked into fairly strong coarse sheeting by the natives in every village. It is first combed or carded by means of two brushes (boards six to nine inches with handles), studded with vertical steel wires. The lengths are spun into thread, and apparently have to be wound and re-wound two or three times before the thread is in a fit condition for weaving. This process of winding seems to require exposure, and sometimes one sees the threads pegged out in a great square with sides forty to fifty feet long, round which a slave with a spindle walks carefully."' 'When

the natives have been educated up to agricultural pursuits doubtless the cultivation of cotton will receive due attention, and experiments at the different botanical stations on the Coast have proved that Egyptian, Sea Island, and five other varieties can be grown with little care.' African series.

But a more instructive account, from the scientific standpoint, is perhaps that written by M. Yves Henry, Director of Agriculture in French West Africa (*l.c.*). Chapter II. of that paper will be found to discuss fully the varieties and races of the cotton plant met with in Senegambia. Henry, while he places all these under *G. punctatum*, admits that they vary to an extent that hardly admits of their constituting but one species. He, moreover, states that for the past eighty years new forms have been almost continuously introduced and experimented with, and since grown side by side with the indigenous stocks, have interbred to such an extent that many years' research would be necessary to unravel the mystery of their specific and varietal existences. The subject, he admits, is one of supreme interest in view of success in cultivation. It is imperative to understand their nature, their needs, and their aptitude for improvement. All the varieties of the indigenous plant, he then adds, may be reduced to three chief forms:— Senegambia.

(1) *N'Dargua.*—This is the form most widely and abundantly cultivated, and is met with in the provinces of Sereres, Sine-Saloum, Djoloff, Cayor and Oualo. It is called *lado* by the inhabitants of the Senegal valley. Indigenous: G. punctatum.

The young shoots and under surfaces of the leaves are covered with a more or less abundant pubescence and prominently black-dotted. The flowers are yellow with purplish throats. The seeds bear a fuzz and an outer coat of short white coarse but strong wool.

(2) *Mokho.*—This is less cultivated, because of its low return. It is chiefly met with in Sereres province. Is a much smaller plant than the preceding, and has small 3-5-lobed leaves, the lobes being obtuse and the shoots glabrous. The cotton is scanty, but very white, fine and silky. When woven this particular staple is found to dye readily, and is much preferred for textiles intended to be dyed with indigo. It is known to the people of the river valley as *rimo*, and is a late-ripening form, the harvest not commencing before January and being continued till April. G. obtusifolium.

(3) *N'Guine.*—Of all the forms of cotton met with in Senegambia this is the least valued, because of the reddish colour of the wool. G. purpurascens.

It is (M. Henry seems to believe) but a less highly cultivated state of *n'dargua* and is met with here and there all over the colony, in small patches and generally on inferior soils. The leaves are large, glabrous, entire or deeply 3-5-lobed, and the seeds appear to be naked. The crop matures about November.

Perennial cottons.

All three forms would seem to be mostly perennial and to yield crops for three to ten years, the stems being ratooned. In the first year the crop is much less than in the second and third, but subsequently it would seem to decline. M. Henry evidently thinks a perennial stock a necessary adaptation to the soil and climate of the country, which possesses relatively a low rainfall and has a soil that cannot be regarded as retentive of moisture. There would appear to be three seasonal cultivations applicable to all three forms of cotton—namely, (*a*) Winter cultivation, where the cotton is sown in lines between millet, the sowings being made in September. This is the most generally followed system. Then there is (*b*) a Summer sowing on the banks of the river, the seeds being sown from time to time as the land is revealed by the falling of the river. This, though not stated by M. Henry, obviously must be an annual crop, as the plants would be killed by the rise of the river. Then, lastly, there is (*c*) Irrigated cotton. This would seem, however, to be rather a projected new direction than a system pursued to any material extent by the Natives. The first experiments of this kind, our author adds, were made by M. Th. Lecard, at the station of Richard-Toll, in 1865.

Seasons.

Determinations.

It would, from the descriptions furnished, almost seem as if the cotton known as *N'Dargua* was *G. punctatum; Mokho*, a plant allied to *G. obtusifolium*; and *N'Guine* very possibly *G. purpurascens*. These are only conjectural determinations, and cannot be accepted until the plants have been compared with the types of the species in question. I have, however, seen several specimens of *G. obtusifolium var. africana* from Senegal, so that in suggesting that species for the *mokho* cotton I am guided by evidence that all but justifies my doing so and have little hesitation in concurring with M. Henry that the *n'dargua* is *G. punctatum*. Specimens recently sent to me from Senegal are unquestionably cultivated states of *G. punctatum*.

Gold Coast.

Under the paragraph above, where specimens seen by me have been mentioned, it will be found I enumerate several recent collections, such as those contributed by Mr. W. H. Johnson and by Mr. G. C. Dudgeon, Superintendent of Agriculture for the British West African Colonies and Protectorates, both sets having come from

the Gold Coast. While, of course, there are other species grown in West Africa than *G. punctatum* and its associate *G. hirsutum* (as, for example, *G. peruvianum*, see p. 213), the *G. punctatum* series constitutes so very important a feature of the cottons of the Colonies and Protectorates named, that it is convenient to allude to the West African cotton fields collectively in this place. As part justification of this course it may be added that no surer evidence of the possibilities of the future can be obtained regarding any country than from the study of the indigenous or more prevalent species there met with.

British Cotton-Growing Association.

In a paper on 'The Work of the British Cotton-Growing Association,' Mr. John C. Atkins, Secretary, submitted to the Third International Cotton Congress, held on June 25, 1906, many interesting particulars regarding the present day West African cotton cultivation. The following abstract may be useful:—

Sierra Leone.—Of this colony he concludes by saying: 'Taking all things into consideration, despite the apparent failures of the past two seasons, the Association looks confidently to the future.'

Gold Coast.

Gold Coast.—Of this region he remarks: 'For two years an experimental farm has been carried on at Labolabo, on the Volta River, by the Government of the Gold Coast, and the Association has contributed a considerable amount towards the expenses. The results have been satisfactory, and good cotton has been grown from American seed. . . . So satisfied is the Association with the prospects that arrangements have been made to take over the work hitherto done by the Government, they giving a grant towards the cost. It is intended to push matters energetically, and gins and presses have been sent out, and next season a power-ginnery will be erected. . . . It is confidently expected that very shortly several thousand bales of cotton will be produced in this colony, and that the efforts of the Association will be fully justified.'

S. Nigeria.

Southern Nigeria.—Mr. Atkins observes: 'It is in Lagos (which has recently been incorporated with Southern Nigeria) that the greatest development has taken place. The Association started a small ginnery at Aro, Abeokuta, on the railway, about sixty miles from the coast, in 1903, the total number of bales exported in that year being 200. . . . In 1905 this was increased to 5,000, and this year over 10,000 bales are expected. . . . The Natives of the Hinterland of Lagos are all agriculturists, and take readily to growing cotton. . . . The plantation of Ibadan has not up to now proved very successful, but some good cotton has been grown from various

American seeds. . . . It is necessary to find an imported or hybrid variety that is better than the native, which is rough and poor in colour, but fair in staple and strong. . . . The quality of cotton from Lagos now coming forward is better than last year's crop, thus showing that the Natives are using better seed and taking more care in its cultivation. Most of the shipments have fetched prices ranging from the value of Middling American to 20 points on. Several lots have been sold at 25 to 40 points on, this being the quality most needed in Lancashire.' Mr. Atkins, after giving particulars of several localities where special efforts are being made, concludes by saying: 'There is no doubt that the cotton-growing industry is now firmly established in this colony, and the knowledge that the Association has guaranteed to purchase at a fixed price all cotton grown has given confidence, and the Association is now convinced that a very large quantity of useful cotton will be grown in the immediate future.'

Satisfactory results.

N. Nigeria.

North Nigeria.—'In this Protectorate,' says Mr. Atkins, 'there is an enormous quantity of land (larger than the whole of Texas) suitable for cotton-growing, and a large population of agriculturists of a type superior to that of the natives near the coast. Cotton has always been grown in this territory and there is a very large business in native cotton cloth.' Particulars are then given of the centres of the Association's operations, and Mr. Atkins next observes, 'There is one great obstacle to a rapid extension of cotton-growing, and that is the want of transport. . . . This question of transport is of vital importance, and the Colony cannot be developed, nor can the British Cotton-Growing Association carry its schemes to a successful issue if this is not improved.'

Togo-land

It is understood that vigorous efforts are being made to extend cotton cultivation in West Africa, and for this purpose American expert cotton-growers have been sent to the British possessions. In the same way the Germans are putting forth strenuous efforts in Togo-land. It seems highly likely that some of the forms of this species may engage attention and be employed at least as indigenous stocks to be improved. The specimens mentioned above, in fact, show that this is the case. But reasoning purely from botanical considerations, it seems highly probable that, so far as exotics are concerned, greater success may be attained on the west side of Africa with Uplands rather than with Egyptians.

An extensive series of references might be given to publications

on cotton cultivation in West Africa. The following may be consulted as having a bearing very possibly on the present species:—[*Kew Bull. Add. series II.* 1898, 11–19 *and* 23–27; *Board of Trade Jour. Oct.* 24, 1901; *June* 1903, 467; *Aug.* 27, 1903, 415; *Nov. 5th*, 1903, 273; *Dec.* 10, 1903, 499–500; *Jan.* 7, 1904, 11; *Sept.* 1904, 445–6; *Dipl. and Cons. Report, n.* 3312, 1903, 10–11; *Berichte über Land und Forstw. in Deutsch-Ostaf. I.*, 1903, 195; *Lady Lugard, Cotton-growing in Nigeria; Operations French Col. Cot. Assoc. West Africa, in Board Trade Jour.* 1904, 12–13; *Bull. Imp. Inst.* II., 1904, 125–6; II., 1905, 249–59, *&c.*]

American series: Moqui cotton.

America.—Mention has been made of the fact that the *moqui* cotton of Arizona is a form of the present species *G. punctatum, var. jamaica.* Drummond found it also in Alabama, and Palmer and many other collectors have brought it from Mexico and Florida. There can be thus no doubt that a series of forms quite as numerous and important as those mentioned in connection with Africa originated in America and played an important part in the evolution of the prized cottons of that country to-day. This subject has, perhaps, been sufficiently indicated in the remarks made under the opening paragraphs regarding the present group of fuzzy-seeded cottons, the more so since it will have to be taken up again under *G. hirsutum.*

Description.

The *moqui* cotton of the Indians of Arizona (of which a specimen has been supplied to me by Mr. Lyster H. Dewey) is, as already stated, but one of the many cultivated states of the present species except that the leaves are larger than is customary. It may be described thus:—Young shoots thick fleshy pilose, later firm, angled and glabrous. Bracteoles very slightly united, glabrous and smooth, bractlets only rarely visible. Flowers small lemon yellow, tinged purple, but claws not coloured. Closely allied is the so-called Texas wool which has medium-sized almost glabrous leaves and large coarse seeds with a dark green fuzz and short dirty-greenish coarse wool.

A further sample, said to be also 'Moqui Indian' cotton, has been sent to me from Egypt by Mr. W. Lawrence Balls, and has preserved in the minutest detail its characteristics with that grown at Washington from Arizona seed.

Moqui from Egypt.

The Egyptian form is perhaps a little more pilose than the Arizona. Mr. Balls observes that the *moqui* cotton plant is of special interest in Egypt on account of its remarkably early maturity.

It has been crossed with a very long staple Egyptian cotton, with the result of a long staple early maturity stock having been produced (see pp. 223–4). But *moqui* differs botanically only very slightly from the *molango* cotton (see p. 231), except that the latter has been hybridised possibly with *G. hirsutum*, or has been derived from *var. nigeria*, not *var. jamaica*.

Hybrids.

I am disposed, however, to accept the 'Hindi weed' of Egypt as but an older acclimatised (and possibly recessive) hybrid of the *moqui* (or perhaps rather of the *n'dargua* of Senegal) than the *moqui* presently grown. Botanically the two plants can with difficulty be separated. To the circumstance of the 'Hindi weed' being a ferine hybrid, possibly possessed of a strain of *G. vitifolium*, is due the fact that small linear obtuse bractlets are often present although the glands (they are supposed to protect) seem frequently absent or imperfectly formed. The following interesting passage from Mr. Balls' letter that accompanies his specimens of this plant I may take the liberty of here giving: 'The plant labelled "Hindi" is of especial interest out here because it is a worthless "weed" cotton which is very common in the fields among other cottons and reduces their commercial value. It hybridises with the others and the Mendelian splitting forms from the cross are very common, and also go under the name of "Hindi," though they are usually very tall up to three metres. "Hindi" itself is about one metre high, and except in its seed reminds me of American Uplands.' The other stocks alluded to by Mr. W. Lawrence Balls, with which the 'Hindi weed' hybridises, are, I presume, the *abassi*, *mit afifi*, and other Egyptian cottons—which, from the specimens supplied to me under these names, I have no doubt are races of *G. peruvianum* (see p. 224). This is in itself a circumstance, therefore, of interest, since some of these (or corresponding races at least) have originated very possibly in what is, to all intents and purposes, the very country of the *moqui* cotton. And it may be added that from the time of Rohr downwards the indigenous or long acclimatised cottons of South and Central America are described as Indian cottons, hence very possibly the origin of the name 'Hindi' cotton. Lastly it may be here added that King's Improved **(see Plate No. 31 B)** is a cotton so closely allied to the other special forms mentioned above that there would seem little doubt of its being one of the most highly cultivated states (a hybrid very possibly) of *G. punctatum, var. jamaica.* (Cf. under Uplands p. 233.)

Hindi Weed of Egypt.

King's Improved.

28. **G. HIRSUTUM**, *Linn., Sp. Pl. 2nd Ed.* (1763) II., 975 (*non Herb. et non Syst. Nat.*); *founded on Miller, Gard. Dict. 7th Ed.* (1759), *n.* 4, *also 8th Ed.* 1768; *G. LATIFOLIUM, Murray, Comm. Soc. Reg. Gott.* (1776) VII., 22–25, *t.* I.; *G. HIRSUTUM* (*in part*), *Swartz, Kongl. Veten. Akad. Handl.* (1790) XI., *N.S.*, 22–23 (*excl. most synn. also the expression 'seeds adhering'*); *Green-seeded cotton, Edwards, Hist. Jamaica* 1793, II., 269; *G. HIRSUTUM* (*in part*), *Willd., in Linn., Sp. Pl. 4th Ed.* (1800), 805 (*excl. synn. and description of seeds adherent*), *also G. LATIFOLIUM, Willd., l.c.* 806; *? Muselin Cotton, Rohr, Observ. sur la Cult. du Cot.* 1807, 57–61; *G. HIRSUTUM* (*in part*), *Poir., Dict. des Scien. Nat.* 1818, *vol.* XI., 37–8; *G. HIRSUTUM, Tussac, Fl. Antl.* 1818, *vol.* II., 67; *G. LATIFOLIUM, DC., Prod.* 1824, I., 456; *G. HIRSUTUM, Roxb., Fl. Ind.* III. (1832), 187 (*describes the seeds as free*); *Macfadyen, Fl. Jam.* (1837) I., 74–5; *G. BARBADENSE, Wight, Ill. Ind. Bot. I.* (1840), 57–64, *t.* 28*c*, *Upland Georgian or Short Staple*; *G. HIRSUTUM, Upland Georgian Cotton, Royle, Cotton in India*, 1851, 138 (*in part*), *t.* III., *f.* 4; *Georgian, also Egyptian Cotton grown in Peru, Spruce, Cult. of Cotton N. Peru*, 1864, 64–7; *G. HIRSUTUM, Parl., Sp. dei Cot.* (1866) 41, *t.* V., (*but exclude some synn.*); *G. HERBACEUM* (*in part*) *Oliver, Fl. Trop. Af.* 1868 I., 211; *G. HIRSUTUM, Todaro, Relaz. dei Cot.* 210; *G. HIRSUTUM* (*in part*) *Vesque, Traité de Bot. Agri. et Ind.* 476; *Schumann, in Martius, Fl. Brazil*, XII., *pt.* III., 581; *Heuzé, Le Pl. Indust.* 1893, I., *3rd. ed.* 142; *G. HERBACEUM, var. hirsuta, Engler and Prantl, Pflanz.* III., *n.* 6 (1895), 51 *f.* 23 (*after Parl.*); *G. HIRSUTUM, L.* (*in part*) *Engler, Die Pflanz. Ost afr. p.* 386; *Riqueza Cotton, according to Branner, Empire Brazil, U.S.A. Dept. Agri. Misc. n.* 8, 1885, *p.* 30; *G. HIRSUTUM, Aliotta, Riv. Crit. Gen. Goss.* (*exclude many synn.*) 76–85; *G. HERBACEUM, Small, Fl. Southeastern, U.S.A.*, 1903, 778; *G. HIRSUTUM, Mill., in Gammie, Ind. Cot.* 1905, 8.

Green-seeded cotton of former times; subsequently known as New Orleans and Georgian, Short Staple American, Saw-ginned Dharwar, *Kadayo* of Bhavnagar, &c., the *Tonje-manga* of Zambesi.

Description.

Under cultivation this plant varies in many directions. It is usually a coarse, stunted, much-branched, erect, greenish-red, dust-coated bush, the last-mentioned peculiarity being a consequence of the abundance, length and strength of the hairs with which the

shoots, leaf stalks and veins are clothed. The leaves rapidly lose the habit of being entire, and are mostly 3-lobed, or as a result very possibly of hybridisation, or simply of luxuriant cultivation, become partially 5-lobed. The flowers range from being small pale yellow to large and yellow with a purplish tinge, but are not as a rule nowadays possessed of dark-coloured patches on the claws of the petals, although these, as already pointed out, are distinctly present in Miller's type of the species. The fruit is usually four-celled and the seeds always large, ovate truncate on one extremity and with a pronounced fuzz, which may be greyish, rusty or green in colour, often changing colour with maturity and age.

It seems unnecessary to attempt a detailed description of this species, since it is practically only a cultivated state of *G. punctatum* already fully defined. In fact, these two forms have been separated mainly with a view to secure recognition of what would appear to have been the original habitat of the species, namely the localities where it either exists in a truly wild condition or as a completely acclimatised plant. It has similarly been thought desirable to retain the name first given to the wild plant rather than to sink all the manifestations that exist under the still earlier name for the cultivated states. After a little study it is fairly easy to isolate the wild from the cultivated conditions, and hence separate names for them become a matter of convenience, if not of scientific necessity. **(See Plates Nos. 29, 30 and 31.)**

New and Old Worlds.

Habitat.—Reported from Europe, Persia, China, Java, India, Africa, throughout America &c. Small (*l.c.*) speaks of it as 'In fields and waste places, Virginia and Arkansas to Florida and Texas.' Heuzé remarks that it came originally from Jamaica and the warm parts of South America.

Herbaria specimens.

Citation of Specimens.—The Sloane Herbarium of the British Museum contains (vol. 133, folio 14) a specimen of this plant, described as 'Cotton from Carolina' **(see Plate, No. 29 B)**, and it will be observed the flowers have purple spots. This is apparently the oldest specimen extant. The volume in which it occurs is described as containing plants 'gathered and dried by order of Mary Duchess of Beaufort.' The exact date of the cotton specimen is not shown, but the Duchess died in 1714. It seems likely the seed had been obtained from Carolina, and the specimen preserved was from a plant grown by her Grace at Badminton in Gloucestershire. It is also probable that Philip Miller obtained seed from this Badminton stock. His specimen (grown at the Chelsea Physic Garden) is preserved in the Miller Section of the Sloane Herbarium (vol. 294, folio 45), and is the type of the species **(see Plate, No. 29 A)**. Turning now to the general Herbarium (British Museum), there are several sheets of this species gathered from the Chelsea

Purple spots.

No. 29. GOSSYPIUM HIRSUTUM, *LINN.*

(A) Type of the species in Sloane Herb. B. M., Vol. 294, f. 45 (Miller's specimen named by himself). (Cf. *G. hirsutum*, Linn. Herb. Plate No. 21); (B) Sloane Herb. B. M. (Duchess of Beaufort's specimen from Carolina).

garden, some of which are named in Miller's own handwriting (see **Plate, No. 31 A**—a plant which, it will be seen, has, like King's Improved (B), also got purple claws to the petals), and these may therefore be accepted as supplementary types. A little later, a Mr. Millington sent to Sir Joseph Banks a series of samples of this plant from Jamaica. These are named in Driander's handwriting (who at the time was Sir Joseph Banks's private secretary), so that their date may be accepted as approximately 1782. One of these is named 'Vine Cotton,' another 'Persian Tree Cotton,' and a third 'Nankeen Coloured Cotton.' Coming down to more recent dates, Rugel collected this species in North Carolina in 1840, and his specimen (Herb. Shuttleworth) is named *G. herbaceum*—an error that was current for many years in both Europe and America, *that* botanical name being given to all short staple American cottons. Lastly, a sample (Herb. Miers) from Coimbatore, India, is called 'New Orleans Cotton'; this is perhaps a hybrid between *G. hirsutum* and *G. purpurascens*. Herbaria specimens

The following are some of the more interesting examples in the Herbarium of the Royal Botanic Gardens, Kew:—EUROPE, PERSIA, &c.: 'Albanicum Alterum, Cult.', Baldacci, n. 167; Aschabad, Transcaspian-Persia, J. Freyn, n. 1,164. CHINA: Shanghai, ? W. R. Carles, n. 388; Pakhoi, South China, G. M. H. Playfair, n. 102, ('This plant does not seem to be cultivated or utilised in any way.' It is possibly a naturalised hybrid, but possesses some of the characteristics of *G. peruvianum*). JAVA: Zollinger, n. 3,562. INDIA: United Provinces, Saharanpur, Hook. f. and T. T. —Jameson's and Thomson's specimens. AFRICA: Livingstone's Zambesi Expedition, Kirk, n. 284 (the *Tonje-manga* Cotton, found between Tette and the coast); Gold Coast W. H. Johnson, n. III. (cultivated in 'Anum Cotton Farm, introduced many years ago'); Egypt, Kordofan, Dr. Pfund, n. 496.

In the Cambridge University Herbarium there are two interesting specimens of this plant, both collected by G. McCarthy, one in Carolina in 1885, and the other at Eufaula in Alabama in 1888. Both are almost typical *G. hirsutum*, and thus differ materially from the Upland cottons of to-day.

In the Edinburgh Herbarium there is an extensive series of specimens of this species (named *G. arboreum, G. arborescens, G. vitifolium, G. peruvianum, G. ægyptiacum* and *G. barbadense*), chiefly contributed by Dr. Jameson from the Saharanpur Botanic Gardens, India; in these the fruits are mostly 4- never 5-celled. There is also in Edinburgh a further series from the Saharanpur Botanic Gardens, in which the seeds have but an imperfect fuzz, and the plants manifest other indications of being hybrids approaching *G. mexicanum*. It is instructive to observe that many of the sheets (of these two sets) are said to have been grown from Egyptian seed or to be Egyptian cottons. But not one of them could for a moment be mistaken for the *abassi* and *mit afifi* cottons of to-day. They have, as a rule, large, completely fuzzy seeds, and the leaves are broad as in the *G. hirsutum* × *mexicanum* Uplands of America. In only one example is the fruit 3-celled, and that one has the seeds almost naked, but the leaves are those of *G. hirsutum*.

From the Herbarium of the Bureau of Plant Industry, Washington, I have had the extreme pleasure to receive an extensive series of Upland cottons, some of which might perhaps be treated as forms of this species,

but the majority are nearer to *G. mexicanum*. I have accordingly dealt with them collectively under *G. mexicanum*.

In M. de Candolle's herbarium, Geneva, the following may be specially mentioned: Cagliari, Thomas, 1836; Murray, Jamaica, nn. 72 and 122.

In the Herbarium of the R. E. P. Calcutta, there are the following among other examples of this cultivated plant: n. 1,750, collected in Bhavnagar, Kathiawar in 1894; n. 1,781, Verawal in 1894; n. 10,513, Dhanodi, Ellichpur in 1894; n. 12,876, Mysore 1899; n. 21,828, Manjri Farm, Poona (called Brazilian cotton); and n. 22,011, also from Manjri Farm (called Peruvian cotton).

Mistake made.

Nomenclature.—In 1696 Plukenet described and figured a *Gossypium* ('Alm. Bot.' II. 172, and 'Phyt.' t. 299, f. 1), the original specimens of which may be seen in the British Museum, and have been discussed by me under *G. Nanking*, p. 119. Linnæus gave no citation of that plant in his 'Species Plantarum,' but in the 'Systema Naturæ,' 1767, II., 462, he seems to have made the mistake, manifest in his herbarium, of confusing a New World hirsute plant, having leaves entire or 3-lobed, with an Old World hirsute species, with leaves 5-lobed. There are other characters that separate these two plants, but it is sufficient for the present to thus indicate the mistake. It follows that *G. hirsutum, Linn. Syst. Nat.* has to be treated as *non. Sp. Pl.*

Miller's plant.

In founding the species *G. hirsutum*, Linnæus gave in the 2nd ed. of the 'Species Plantarum' (1763), p. 975, the following description, '*Gossypium foliis trilobis quinquelobisve acutis, caule ramoso hirsuto, Miller, Dict. n.* 4.' The species was, therefore, that described by Miller, and the type as already affirmed is of necessity the plant in Miller's Herbarium now incorporated in the Sloane Herbarium (vol. 294, folio 45). This is moreover supported by several other specimens, which were grown either at the Badminton or the Chelsea gardens, some of which in Miller's own handwriting bear the date 1732. Miller's type, as shown above (**Plate No. 29 A**) bears (in Miller's own handwriting, also reproduced), the description, taken from Tournefort ('Inst. rei Herb.' 1719, I., 101). In 1731 Miller published the first edition of his Dictionary. He there refers to a species (n. 2) as follows: '*Xylon Americanum præstantissimum semine virescente,*' and thus gave the same descriptive quotation, as shown on his specimen, except that he incorrectly assigned the original source of information quoted by Tournefort as being Ligon instead of Lignon. In passing it may be mentioned that Richard Ligon wrote a History of Barbados, in 1657, but makes only the most casual mention of cotton

Richard Ligon.

No. 30. GOSSYPIUM HIRSUTUM, *LINN.*

Photographic reproduction (half life size) of a coloured drawing, prepared under my supervision, and showing as near as possible the typical form of the species.

(*a*) Round four celled boll : (*b*) the bud showing shape of calyx and the floral glands : (*c*) green fuzzy seed.

(though he describes the noteworthy plants seen by him, and gives minute details of the recently introduced industry of sugar-planting.

The brothers Lignon.

The two brothers Lignon (quoted by Tournefort, *l.c.* 1719, p. 101), communicated information to the great French botanist regarding the plants of the American islands, more especially of Guadeloupe, and were apparently the original authors of the expression 'the very excellent American cotton with green seeds.'

Whether Miller was correct or not in identifying his hirsute plant with green seeds, which he grew in the Chelsea Garden, with the plant referred to by Tournefort and the Lignons, may be a matter of some uncertainty—the alternative would be *G. peruvianum*. Miller continued to transcribe, however, the information furnished by the Lignons through the succeeding editions of the Dictionary down to the 6th (1752), when he changed its position in the series by making it No. 4, separated it from the other species with which it had been confused by Tournefort, and added his own description of it. But Miller's additional and more precise information regarding the plant was not likely to have been seen by Linnæus in time for incorporation in the first edition of the 'Species Plantarum' (1753), and in consequence *G. hirsutum, Linn.* was not published botanically until the second edition of the 'Species Plantarum' (1763), by which time the seventh edition of Miller's Dictionary (1759) had been issued, and the eighth edition came out simultaneously with the new issue of the 'Species Plantarum.' But the opinion may be hazarded that the Guadeloupe plant, so highly commended by the brothers Lignon, may have been carried by the French colonists to America, and from that source may have been derived the seed cultivated at Badminton and which was spoken of as obtained from California. **(Plate No. 29 B.)**

Miller corrects the description.

We know at all events that much interest was taken in this plant the world over shortly after its discovery. It was recognised as an immensely superior stock to the Levantine plant, previously grown (*G. herbaceum, Linn.*).

Ehret's floral pictures.

About the time in question also the highest society in England had a new inspiration through the genius of Mr. G. D. Ehret, the water-colour painter of flowers and fruits, who married Philip Miller's sister [cf. FRONTISPIECE, which represents one of Ehret's sketches]. A collection of his original water colourings, which date from 1748, is preserved in the Botanical Department of the British Museum. A small volume of these is entitled 'New and Rare Plants,' among which No. 15 is an unfinished sketch of *G. hirsutum, Linn.*, named '*G. semine*

virescente.' This, it is safe to assume, had been sketched from a specimen furnished by Philip Miller, and possibly as a consequence of the interest taken in the plant by the great horticulturist. There can thus be no doubt that considerable attention was paid to this plant, for in the Duchess of Beaufort's herbarium (also a portion of the great Sloane Herbarium of the British Museum), there are several specimens of it, one (Vol. 133, folio 14) to which reference has already been made. The Duchess was born somewhere about 1630, and died in 1714, so that her collection of plants must have been mainly made within the latter half of the seventeenth century.

Firmly attached floss.

Miller makes special mention of the wool of this species adhering firmly to the seeds, hence necessitating special gins. It was this difficulty that was finally overcome by Whitney in 1793, by the invention of the saw-gin. But to the frequent discussion of the firmly attached floss is due very possibly the error committed and perpetuated by several subsequent authors of describing the seeds as 'adhering together.'

Seed sent to Georgia.

In 1734 we read that cotton was raised in Georgia from seed supplied to the trustees by Philip Miller, of Chelsea, and in the eighth edition of his Dictionary (published 1768), Miller, commenting on this plant, urges that 'it is well worthy the attention of the inhabitants of the British Colonies in America to cultivate and improve this sort.' That hint was apparently acted up to, for by 1786 the green-seeded cotton had become the sort chiefly grown in America. But the present explanatory note of the synonymy of this species would not be complete without one or two further particulars. Linnæus' own copy of the second edition of the 'Species Plantarum' is preserved in the library of the Linnean Society of London. In that volume certain MS. corrections and additions were made by Linnæus himself, doubtless in anticipation of a future issue of that work—never published by him. For example, the passage from Tournefort ('Inst.' 101, quoted above), is struck out, and a reference made to Plukenet ('Alm.' 172, t. 299, f. 1). It would thus seem likely that Linnæus contemplated the correction of *G. hirsutum*, from being the plant Miller intended by his description, supported by his specimens, into that in the Linnean Herbarium, which is *G. obtusifolium, Roxb., var. Wightiana* (see reproduction Linn. specimens, **Plate No. 21,** and compare with **Plate No. 29 A,** which shows the true *G. hirsutum*). Accordingly, Linnæus observed, in his further remarks, that it differed from *G. herbaceum* in the obtuse lobes of the leaves, the position of

Corrections made by Linnæus.

the glands, and in being biennial. But, be it observed, these corrections have never been published, and are mentioned here in order to show that with Linnæus himself originated the error of confusing Miller's West Indian *G. hirsutum* with the Indian *G. obtusifolium*. Subsequent botanists went a stage further and confused both these with *G. herbaceum*.

The earliest and one of the best published plates of *G. hirsutum, Linn.*, is that given by Murray (1776), who furnishes a detailed description. He did not, however, know the country whence it had been obtained, since the seed cultivated by him had been supplied by Professor Spielmann of Strasburg, who wrote on the packet, *G. macedonicum*. Bryan Edwards ('Hist. Br. Col. Jamaica,' 1793, II., 268) speaks of green-seeded cotton as the form with the wool adhering so firmly that it had to be hand-picked. In his time cotton cultivation had practically been abandoned, and the present species was that used by the sugar-planters for making wicks for their oil lamps. There were two forms recognised, and both had the advantage of flowering and fruiting early. Jamaica plant.

Of the older authors who deal with cotton from the standpoint of the planter, Rohr occupies a foremost place. He lived in Sainte-Croix for some years, and from 1785 to 1790 conducted a searching inquiry into the best cotton plants and the most satisfactory methods of their cultivation. In his little book (*l.c.* 57-61) he discusses four kinds under the name of 'Muselin Cottons.' The best of these he procured from Jamaica. He gives such particulars as to leave little doubt as to the botanical determination here given being correct. The seeds when fresh were coated with a green fuzz and a firmly adhering floss. There was also a white and a red kind, the latter being most probably the *var. religiosa* (below). Sainte-Croix plant.

Not only has *G. hirsutum, Linn., Syst. Nat.*, to be excluded from this species, but the *G. hirsutum of Lamk., Cav., Swartz.. and Willd.*, as well, since all these authors laboured under misconceptions regarding the plant. Lamarck, for example, explains that in pursuance of the fact that Linnæus accepted Plukenet's table 299 f. 1 (**see Plate No. 15 B.**) as manifesting his plant, the description of the bracteoles had to be amended to 'ovate entire' from 'deeply incised,' as some authors had supposed them to be. When it is recollected (as I have shown above) that the flowers published by Plukenet were drawn from imagination (are not at all events present on the specimen **15 A.**), Lamarck's *G. hirsutum* with ovate entire bracteoles falls Misconceptions. Description made to suit the picture.

to the ground. Cavanilles was on more sure ground. He possessed a botanical specimen of a plant grown in Paris which he identified with Plukenet's plate. His description and admirable illustration denote, however, *G. Nanking, Meyen,* so that his *G. hirsutum* must be reduced to that species.

White Siam cotton.

In passing it may be here pointed out that the habitat Barbados, given by Plukenet, and America, given by Cavanilles, are at first sight difficult to explain. But it is a matter of history that the French colonists endeavoured to acclimatise 'White Siam Cotton'—a cotton much talked of at that time—in the State of Louisiana during 1758, so that the plants grown in Paris may quite easily have come from that source. Both Swartz and Willdenow described the seeds of *G. hirsutum* as being adherent, a circumstance, as I have already stated, that misled many subsequent writers and even justified the amalgamation of *G. brasiliense* (*G. religiosum* of certain writers) with the present species.

It is, perhaps, hardly necessary to repeat that the specimens named *G. hirsutum* by Linnæus himself, in his own herbarium, are not the species of that name indicated in the 'Species Plantarum,' but correspond with the plant in the 'Systema Naturæ,' and represent the cultivated Indian plant that has recently come to bear the name *G. Wightianum, Tod.* Hence, as already affirmed, the confusion of a hirsute American (or possibly West Indian) plant having leaves mostly 3-lobed with an Indian hirsute plant with leaves mostly 5-lobed, has disfigured the literature of cotton down to the present day, and possibly accounts to some extent for the reputed failures to cross-breed American and Asiatic stocks.

Failures at crossing.

Cultivation.

Trevor Clarke's opinion.

Hybridisation and Selection of Stock.—Major Trevor Clarke, who devoted much attention some years ago to the study of the methods of improvement of cotton, gave it as his opinion that it was not possible to cross the green-seeded American cotton with the Asiatic races. There is only one specimen of Major Clarke's in the Kew Herbarium, and that is most curious. It is evidently a hybrid, but derived mainly from *G. purpurascens* crossed very likely with *G. punctatum.* It has the leaves of the former with the pilose condition of the latter, but the seeds shown along with the sample are very large, coarse, and densely coated with rusty fuzz, so that if they can be accepted as having belonged to the specimen, its

punctatum element must be regarded as having been very strong indeed. If this was the stock Major Trevor Clarke operated on, there would very probably be little to be surprised at in his failure to still further hybridise it with the Indian cottons. The label attached to Major Trevor Clarke's plant has the following note:— 'Branch of Cotton plant (*Gossypium*) apparently the wild form of a marked race, known as the "West Indian Green Seeded." Distinct from but somewhat resembling *G. tomentosum*. Santa Paulo, Brazil, 1873.' The 'green seeded plant' to which he alludes, so far as I am aware, has nowhere been found wild, but it would very possibly have been one of the races of *G. hirsutum*, a plant nearly as different from Major Clarke's specimen as both are from *G. tomentosum*. No wonder then that failure resulted, if experiments at cross-breeding were actually conducted before having had even a fairly accurate conception of the botany of the genus operated with.

Imperfect knowledge and failure.

The type of the species *G. hirsutum*, *Linn.*, *Sp. Pl.*, as already affirmed, is the plant that was grown in the Chelsea Physic Gardens in 1732, and of which seeds were sent to the United States, but to which perhaps sufficient reference has already been made. It was ultimately distributed all over the States, and in time found its way to Egypt and even to India. Roxburgh recognised it as distinct from his *G. obtusifolium*, and referred to it as of late introduced into India. Macfadyen speaks of the Wild Cotton of Jamaica, which he had named as *G. jamaicense*, as closely resembling *G. hirsutum*, except that the latter is hirsute and the capsules, according to Swartz, 3-celled; and the seeds, according to Wildenow, adherent.

Distribution.

There would seem to be no doubt that the plant grown by Miller was much closer botanically to *G. punctatum*, as defined above, than it rapidly became under skilled cultivation. It is, in fact, probable that few cultivated cottons have changed or can be changed more rapidly and completely than the plant here dealt with. The samples seen in herbaria manifest, at all events, an undoubted progression when assorted in sequence of date. Moreover, when procured from countries where little attention has been paid to improvement, or when cultivated under unfavourable conditions (as in India), *G. hirsutum* often becomes hardly distinguishable from *G. punctatum*. For example, Mr. Leo Farmar has recently collected this cotton from a field near the Botanic Station of Hann, in Senegal, which perhaps had best be described as a cultivated state of *G. punctatum* rather than a form of *G. hirsutum*.

Effects of skilled cultivation.

Degeneration.

Indigenous specimens.

If I am correct in thinking that *G. punctatum* may have been indigenous to Alabama, thence west to Arizona and Mexico (**see Plates Nos. 27 and 28 B**), also in the West Indies (the Bahamas, Jamaica, &c.), as well as to Western Africa, it is possible that the colonists in Georgia were not aware of that fact, or recognised the stock procured for them from Europe as superior to any other. That it is indigenous to Africa there can be no doubt. **(See Plates Nos. 27 and 28 A.)**

Uplands of the United States.—Mexican cotton seed (possibly *G. mexicanum*, or in some cases *G. vitifolium*, the plant figured by Hernandez), we read, was introduced into Mississippi in the first decade of the nineteenth century by Walter Burling. It was immediately employed apparently to cross the existing plant (doubtless *G. hirsutum*) with the result, it is said, that the stock was greatly improved. Similarly, there seems no doubt that in the more northern portions of the American 'belt' the plant first grown was the Levant (or, as it was often called, Turkey) cotton. (See Asiatic cotton in Burkett and Poe, 'Cotton,' plate facing page 94). On the green-seeded superior cotton being introduced (1732) it appears to have been at once grown over all the intermediate zone found suited to it, but toward the north and on the higher land it was mainly used as an improving stock on the old *G. herbaceum*, while, as just stated, to the south in the more tropical, flat, moist regions of the Mississippi basin, *G. hirsutum* itself was improved by being crossed with *G. vitifolium* and *G. mexicanum*.

Early crossed.

Multiplication of races.

What has been the result? Through vigorous and continuous efforts to improve the stock, as Mr. Tracey has shown (see Dabney, 'Cotton Plant &c.,' *l.c.*, Chapter on Cultivated Varieties), over 100 distinct races, derived primarily from *G. hirsutum*, have been brought into existence. It is not to be wondered at, therefore, that in the trade there are various grades in what are called short staple cottons, which, by some writers, have been grouped as Georgian and Upland Georgian, while others think these and such like names have hardly any more value than as denoting localities of production.

In 1894 I had the pleasure of receiving an interesting series of botanical specimens, representative of the United States cultivated cottons, in consequence of the kind co-operation of Professor H. H. Rusby. In reply to an inquiry made by me as to how far the cottons of the lower and more southern tracts were or were not *G. herbaceum*, Mr. S. M. Tracey, then Director of the Mississippi Agricultural Station, replied in April 1895: 'I was certainly in error in using the

name *G. herbaceum* as applied to our common American cottons. They are nearly all the offspring of *G. hirsutum*. In recent notes prepared by me I have endeavoured to trace the history of our cultivated sorts, as far as possible, and have found that many of them could be traced directly to the influence of Mexican seed.' In his admirable account of the chief races of cottons now grown in the United States, Mr. Tracey tells us that the course often followed, by the original experimenters, was to plant two or more forms of cotton that it was desired to have crossed, side by side, and each year to sow the seed obtained and watch the result until a desirable hybrid had been thus naturally produced. When a plant appeared that manifested the wished-for cross, it was selected and specially propagated. Of this nature Mr. Tracey mentions the following historic hybrids:— Influence of Mexican seed.

(1) 'Bragg Long Staple'—a cross between *G. herbaceum* and *G. barbadense*. Hybrids.

(2) 'Cobweb'—a hybrid produced from Peeler and an Egyptian variety of *G. barbadense*.

(3) 'Hawkins Prolific'—from Boyd Prolific, Herlong, and New Era.

(4) 'Hunnicutt'—produced from a mixed crop of Bates, Boyd Prolific, Herlong, Truitt, &c.

(5) 'Pollock'—from a long staple cotton with pollen of 'Peerless.'

(6) 'Welborn Pet'—produced from a mixed field of Barnes, Jones Big Boll and Zellner.

These are only indicated because the reports on them specially mention the mixed crops from which the hybrids in each case had been obtained. It does not, however, follow that they are all hybrids of *G. hirsutum*, and in fact, in a further passage, several of them will be shown to be nearer to *G. mexicanum*. They are illustrations of what may be called naturally-produced hybrids or crosses that have been and are being continuously brought into existence.

The majority of the specimens of Upland cottons sent to me fully confirm the existence of influences that have modified *G. hirsutum* in at least two directions—viz. toward the vine-leaved, softly-hairy cottons on the one hand, and a semi-glabrous broad-leaved cotton on the other, both new elements from Mexico, or at all events from South America. To these influences would have to be attributed the circumstance that green-seeded plants had been observed to produce grey or brown or even naked-seeded offspring, or naked-seeded Directions of modification.

Recessive forms.

parents had sometimes yielded fuzzy-seeded offspring. This has been traced to climate, soil, or method of cultivation &c., but without disputing the value of environment as a factor in the multiplicity of cottons (and assuming the stock to be hybrid), the theory of recessive splitting forms—or, as it has been called, the tendency to reversion to one or other of the ancestors—is quite as natural and permissible an explanation as any that can be given.

Mexican stock.

Apart, therefore, from the fact that crossing with Mexican stock has been frequently mentioned by writers on this subject, and further that for years past an almost continuous importation of fresh seed from Mexico into the United States has taken place, the plants themselves give undoubted evidence of a gradual progression from one type to another. Even within my personal experience I can mark this transition. The specimens furnished to me by numerous friends in the United States, but a few years ago, were collectively much closer to the specific type of *G. hirsutum* than seems to be the case to-day. Through the generous co-operation of Mr. B. T. Galloway, of the United States Department of Agriculture, I have recently received from Mr. Lyster H. Dewey, Botanist in Charge of the Fiber Plants Section of the Bureau of Plant Industry, a splendid series of some sixty botanical specimens of the cotton plants at present being cultivated. Of these seven are accepted by me as forms with a strong

A revolution in forms grown.

strain of *G. hirsutum*, whereas something like forty approximate even more nearly to *G. mexicanum*, while the balance are forms of *G. punctatum*, *G. barbadense*, *&c.* In fact, it might fairly well be affirmed that the past twenty or thirty years have witnessed an almost complete revolution in the stock of short staple or Upland cottons of the United States. This, I venture to think, will be abundantly exemplified by a comparison of **Plates Nos. 29 and 31**, which manifest the original or type condition of *G. hirsutum*, the green-seed cotton of Georgia and Carolina in 1732, with **Plates Nos. 41 and 42**, which exemplify two of the many types of present day Uplands. So

Long Staple Uplands.

vastly have these plants advanced and improved that it may be said the Uplands in some instances (Allen, Sunflower, &c.), differ from the Sea Islands alone in the staple being a few millimetres shorter. And speaking of the Allen, Sunflower, &c.—the Long Staple Uplands—remind me also of a curious circumstance—namely, that judged of by botanical standards, they appear to be hybrids of *G. hirsutum* × *barbadense*, and bear little or no trace of a *mexicanum* influence. (Cf. pp. 234–5).

No. 31. GOSSYPIUM HIRSUTUM, *LINN.*

(A) One of Philip Miller's types in Sloane Herb. of B. M. (label in Miller's own handwriting); (B) King's Improved (ff. 1, 2, 3), a form that approximates fairly closely to *G. jamaicense, Macf.* 27 B.

Mr. Dewey, in one of his most valuable letters accompanying the samples sent for my inspection in connection with this publication, gives the following highly instructive sketch of the origin of the cotton cultivation of the United States and of the present species more especially.

American cottons.

'The term "Sea Island" is applied primarily to the form of *G. barbadense*, cultivated on James and Edisto Islands and the adjacent mainland along the coast of South Carolina. The most highly developed Sea Island cotton is grown on the two islands mentioned, where it has been bred up by many years of careful selection. Seed from these islands has been taken inland, where it has been found more profitable to cultivate Sea Island than Upland varieties, and now through Northern Florida and across the southern part of Georgia south of Eastman, Sea Island is grown almost exclusively. This is sometimes called Georgia Sea Island, and occasionally the term is shortened to merely Georgia cotton. The latter term, however, is somewhat misleading, as the name Georgia cotton is also applied to the short-staple Georgia Upland, which is obtained from "King," "Drak," "Peterkin," "Russell's Big Boll," "Jones's Improved," "Truitt," and other varieties, all belonging to the species *G. hirsutum*. In the stiff clay soils and redlands of the northern part of Georgia a cotton of a rather peculiar wiry staple is produced which is somewhat typical of the region, differing in this respect from the finer and more flexible fibre produced in the rich black soils of the delta region of Mississippi and Louisiana. The cottons of these regions, even when grown from seed of exactly the same origin as that of Georgia and eastern Alabama, are usually somewhat longer in staple, and known as delta, Louisiana or New Orleans cottons. The name 'short staple' is applied to all American Upland, distinguishing it from the Sea Island and long-staple Upland. Comparatively small quantities of long-staple Upland cotton are produced, principally in the delta region and in Arkansas and Texas. In some instances this long staple is claimed to be the result of crossing American Upland with Sea Island, but in all cases it is developed by persistent careful selection. The most extensively grown long-staple Upland cottons are "Cook's," "Allen's," and "Griffin's." You have doubtless noticed that American botanists have in nearly all instances referred the American Upland cotton to the species *G. herbaceum*. So far as we can learn, the first cotton cultivated in this country was grown in south-eastern Virginia by the early

Soil.

New Orleans.

emigrants from England, and afterward cotton was grown to a slight extent in Delaware, also by European immigrants. It is probable that this very early cotton was produced from seed brought from Europe, and in that case it was probably *G. herbaceum*. During the last seventy-five years, however, no cotton of that species has been cultivated commercially in this country. The only cottons grown in the United States in commercial quantities are the Sea Island and Georgian Sea Island, belonging to *G. barbadense*, which also includes Egyptian cotton; and the American Upland cotton, comprising more than nine-tenths of the crop, belonging to *G. hirsutum*. This cotton came without doubt originally from Mexico, and is practically the same type as that which the Moqui Indians have cultivated without change of seed for many centuries, certainly long before the coming of white men to this continent.'

Mexican origin.

Fruit 5-celled.

In amplification of the most instructive particulars thus afforded by Mr. Dewey, it may be observed in conclusion that one of the most noteworthy peculiarities of the modern races of Upland cottons is the fact that the fruit is most frequently 5-celled, a condition not so uncommon in *G. mexicanum* but quite unknown in typical forms of *G. hirsutum*. Moreover, the hirsute type has to a large extent been lost, the leaves having become very broad, smooth in texture, and often almost quite glabrous. In fact, a classification of these into hairy and glabrescent forms might almost be accepted as denoting a strong strain of *hirsutum* in the one and of *mexicanum* in the other instance. [For further information see the remarks under *G. mexicanum*, pp. 230–9.]

Tonje manga cotton.

Africa.—Livingstone ('The Zambesi and its Tributaries,' 111) makes the interesting observation: 'The *tonje manga*, or foreign cotton, the name showing that it has been introduced, is of excellent quality, and considered at Manchester to be nearly equal to the best New Orleans. It is perennial, but requires replanting once in three years. A considerable amount of this variety is grown in the Upper and Lower Shiré Valleys. Every family of any importance owns a cotton patch which, from the entire absence of weeds, seemed to be carefully cultivated. Most were small, none seen on this journey exceeding half an acre; but on the former trip some were observed of more than twice that size.' In 1860 Livingstone called attention to the importance of Nyassaland and Shiré for cotton production. Every village had its cotton plots, and from the specimens in Kew Herbarium supplied both by Dr. Livingstone and Sir John Kirk

we know for certain that the present species was fairly extensively grown. In 1875 we are told, however, that on the trade in British cotton goods being established the cultivation of the cotton plant was largely discontinued. But in the 'Board of Trade Journal' (XLVII. Nov. 1904, 349–50) a more encouraging state of affairs is recorded. In the British Central African Protectorate, it is stated, cotton cultivation is extending, aided largely by the railway through Shiré highlands. The 'Diplomatic and Consular Report' (No. 606, Misc. Series, April 1904) gives an interesting statement of the prospects of growing cotton in the East African Protectorate. Edmund D. Morel ('Empire Grown Cotton,' 1904) discusses the cotton cultivation of East and Central Africa, but gives no sort of hint as to the species raised. His account may be accepted, however, as setting forth the conditions that prevail with the species which from herbarium specimens would seem to be that more especially produced, namely, the *tonje manga* of Livingstone.

Influence of imports.

Colonel Alfred J. Arnold (Inspect. Gnal. de Explor. Compia de Moçambique) in a Memorandum dated May 1905 discusses the present position and future prospects of cotton cultivation in Manica and Sofula. These two provinces, which constitute the territory granted by the colony of Portuguese East Africa to the Moçambique Company, together cover an area of some sixty thousand square miles. They are bounded on the north by the Zambesi, and on the west by the British South African Company, and on the south by the Portuguese territory directly administered by the Portuguese Government, and on the east by the Indian Ocean. Colonel Arnold, while he discusses the advantages geographically of the tract of country belonging to the Company, the merits of its climate and soil for cotton cultivation, the nature and extent of the available labour, &c., gives little details of the species of cotton actually grown. It is thus impossible to ascertain to what extent, if any, the present species is being utilised, though it would seem the plant very possibly that may be found best suited. Colonel Arnold reproduces (much reduced) Parlatore's plate n. III.—Sea Island cotton—as a general illustration apparently, but gives particulars of the recent endeavours to acclimatise and cultivate Egyptian cottons. Experiments were first made in the Company's Experimental Gardens at Mambone and Chimoio. Later on an experimental field was put under cotton near Nova Fontesvilla, a town on the railway not far from Beira. The results were so satisfactory that the Company resolved to extend

Moçambique cotton.

Egyptian cottons experimented with.

their endeavours, the site selected being at Cherinda in the coast district of Chiloame. From these beginnings cultivation extended into the hands of private farmers or colonists, the cotton chiefly experimented with being Egyptian *mit afifi* (which see under *G. peruvianum*). The pamphlet issued by the Moçambique Company will richly repay perusal, and it may be added that the prospects of cotton-growing in this portion of East Africa are very encouraging.

Mr. John C. Atkins, in a paper read before the Third International Cotton Congress in June 1906, gives brief particulars of other parts of East Africa. The cotton mostly grown is Egyptian, and will be dealt with under that species, but of South Africa—the Cape Colony, Natal, the Transvaal and the Orange River Colonies—he says very satisfactory results have been obtained with American cottons, by which it may be inferred is meant Uplands, and accordingly a fair proportion can be assumed to be races or hybrids of the present species (*G. hirsutum*). In a recent despatch Lord Selborne observes :—

Transvaal.

'Experiments have been conducted by the Agricultural Department (Transvaal) at several stations. Some excellent samples of American cotton have been secured, which have attracted much favourable comment in Manchester, and at the Cotton Exhibit in London. These samples have been valued at 1*d.* to 1½*d.* per pound more than samples of the American-grown cottons of the same class. There is an extensive area in the Low Veld, particularly on the lower eastern slopes of the Drakensberg, in which it seems probable that cotton can be grown profitably, providing the same quality of lint can be maintained, and if transport, freight, and other charges combined are not too high to leave a margin of profit. Fifty acres are under cotton on our farm this year, from which seven to ten tons of lint may be expected, sufficient, I think, to give us data to the economic possibilities of establishing the industry.'

Saw-ginned Dharwar.

India.—As already explained this is in commerce designated Saw-ginned Dharwar, a name indicative of the locality where the greatest success has been attained in its acclimatisation—Dharwar. Roxburgh had grown it in Calcutta, perhaps thirty years prior to its having been conveyed by the Indian Cotton Commissioner to the Uplands of the Southern Mahratta country.

It would occupy too much space to review even briefly the historic facts connected with this cotton in India. It is by far the most successfully acclimatised of all the so-called American species.

Indeed, in India it has almost reverted to the specific type of *G. punctatum, var. nigeria,* just as in Egypt a similar degeneration (or reversion) has resulted in the so-called 'Hindi weed' which might be described as *G. punctatum, var. jamaica.* In the former the softly hairy condition is preserved, and in the latter the tendency is toward a glabrescent form. It is thus possible that under neglect or defective cultivation the finer strain gradually dies out, and the dominant condition (or original wild form) gradually supervenes. Degeneration. Some such explanation is necessary to account for the admitted degeneration of the Indian Dharwar stock. It is no unusual circumstance to read of a parcel of Dharwar acclimatised cotton having been valued as equal to *Kumpta,* but inferior to Gujarat cotton. Thus, for example, a Memorandum, addressed by me to Sir William Thiselton-Dyer in 1894 (see 'Kew Bulletin,' Additional Series, 2, 1898, 21–2), contains the following, which may be here abstracted: During the first few decades of this century the Honourable the East India Company entertained the somewhat unfortunate opinion that the true way to enable India to participate in the greatly expanding British traffic in raw cotton would be to acclimatise the most highly prized forms of America. Large sums of money were accordingly spent in Bengal, Madras, and Bombay, that might (as we now learn) have been used to better advantage in an effort to improve and develop the indigenous crops. Year by year America steadily improved the quality and increased the length of her staple, and the demand for Indian cotton accordingly declined. Ultimately, however, India succeeded in producing New Orleans cotton at Dharwar —a staple of a far superior quality to the Indian. New Orleans. The high price paid for this, unfortunately, induced adulteration instead of encouraging greater effort. In July 1863, a law had accordingly to be passed to repress the frauds perpetrated, but this, while being wholly ineffectual in its main object, very frequently punished the wrong persons, and accordingly did great harm to the industry. Frauds Act. It was in consequence repealed, and the Indian cotton trade was thus left to take care of itself. The effort to participate in the British traffic had practically to be abandoned, and not because India had been proved incapable of producing a staple of the kind required. But this is not all. The reputation of India for its once famous indigenous cottons had at the same time been completely destroyed, and its American crop having fallen into disfavour, rapidly degenerated in quality, until at the present day it might almost be described as inferior to many of

the indigenous cottons. Unskilled and impecunious cultivators were in India left to compete against the enlightened agriculture of America—unskilled because ignorant of the principles by which they might have developed the produce to meet the best market, instead of being content to allow it to drift into an inferior position. As matters stand, they may now be said to glory in that they are able to dispose of a worthless staple at remunerative rates.

Improvement possible.

That improvement towards a higher and better paid standard is possible may be accepted as fully demonstrated by past experience, and by the fact of superior races of cotton being found where attention is given to the crop, and still more so by the further fact that within the regions of superior production the cultivators are fully aware that degeneration occurs with neglect and with the prolonged continuance of production of any particular form on the same soil. Selection of seed and the cultivation of specially selected plants for the supply of seed might easily improve the Indian crop of any district by 50 per cent.

Uniformity desired.

For many years past the Indian cotton trade has been drifting into a restricted groove. The produce goes to mills that do not wish for a superior or long staple, but only a pure one (that is, not a mixture of several lengths of staple), so that it may fairly be said many of the largest buyers discourage improvement. The dangers of a one-sided trade of this nature need scarcely be mentioned. India is thus destroyed as a possible country of supply for the English mills. The Indian mills are at the same time compelled to look to foreign countries for their present or future supplies of superior staples, and are thus more or less confined in their operations to one class of goods. It might almost be said that progression is deliberately stultified, the labours of centuries ruthlessly thrown away, and a large and important industry practically cornered or restricted in its possible development by interested parties, who advance the plausible axiom that demand is the controlling power of production. Hence improvement of the staple may be emphatically affirmed as the rational direction in which an extension of the production of cotton should be looked for, since the existing traffic is aimed at the destruction of all the good features of the indigenous fibre, if not of the morality of both grower and trader. It is essentially a retrograde traffic, as at present constituted, and one in which the aims and objects of most of those concerned are directed towards the attainment of a high yield of a worthless staple.

Retrograde traffic.

No. 27. GOSSYPIUM PUNCTATUM, *SCH. ET THON.*

(A) Var. nigeria, *Watt*: the wild cotton of Badagry; (B) var. jamaica, *Watt*: the wild cotton of the West Indies and the shores of the Gulf of Mexico.

29. Var. religiosa, ***Watt:*** *G. RELIGIOSUM, Linn., Syst. Nat.*, II. (1767), 462 (*in part*); *G. TRICUSPIDATUM, Lamk., Encycl.* II., 135; *G. RELIGIOSUM, Cav., Diss.* 313, *t.* 164, *f.* 1, *also Cav., Lecciones* (1827), 523; *Nun's Cotton, Rohr, Cult. du Coton,* 1807, *p.* 62; *G. TRICUSPIDATUM, Poir., Dict. des Scienc. Nat.* XI., 1818, 39, *also Turpin, Planches, Dict. &c.* IV., *t.* 42; *Tussac, Fl. Ant.* 1818, II., 65–77 (*excl. t.* 17); *G. CROCEUM, Ham., Trans. Linn. Soc.* XIII. (1822), 491–4; *G. RELIGIOSUM, Roxb., Fl. Ind.* III. (1832) 185–6 (*correctly recognises it as allied to G. hirsutum, but MS. drawing* (*n.* 1497) *is named G. fuscum*) (*reproduced here as* **Plate No. 33**); *G. HIRSUTUM, var. δ lana rufa, Parl., Spec. dei Cotoni,* 1866, 43; *var. rufa, Tod., Relaz., Cult. dei Cot.*, 211; *var. lana rufa, Aliotta, Riv. Crit. Gen. Goss.* 1903, 80; *G. RELIGIOSUM, Small, Fl. Southeastern U.S. America,* 1903, 778.

Nankin or Khaki Cotton, Roman Cotton, Siamese Cotton (of some writers), &c.

Description. The following may be given as the diagnostic characters: shoots elongated slender, the plant in consequence creeping or climbing, internodes long, straight, profusely tomentose; leaves with long petioles, often entire or prominently 3-lobed on the apex (sometimes only 2-lobed or occasionally 5-lobed), lobes triangular acute, stipules persistent, broad, oblique, ovate lanceolate, 3-nerved, sub-cordate; flowers on short angled peduncles, all axillary and having broad deeply gashed bracteoles, and relatively very large, pale yellow flowers without purple spots but turning purple on maturity; calyx teeth, large, triangular; fruits oblong, pointed; seeds with both fuzz and floss, most frequently of the rusty colour seen in the wild cottons. **(See Plates Nos. 32 and 33)**

India, Fiji, &c. *Habitat.*—Cultivated in most tropical or warm temperate countries —India, Fiji Islands, Egypt, United States, &c. Its origin is unknown, but it is perhaps a cultivated state of *G. prostratum, Sch. et Thon.*, in which case it possibly originated in West Africa. Small (*l.c.*) speaks of it as occurring 'along the coast of Florida and Texas.'

Specimens. *Citation of Specimens.*—The most interesting example of this species is the type sheet in the Linnean Herbarium, London. Then there are, in the Herbarium of the Royal Botanic Gardens, Kew, several sheets of this special form—such as the Fiji samples from the Rakiraki Coast, Nayatu (Seemann, n. 28, which has been incorrectly named *G. tomentosum, Nutt.*)

and the samples from J. Gay's herbarium ('Jard. de Morel,' October 1811) (**32 B**). In the Edinburgh Herbarium there is a series of examples from the Botanic Gardens, Saharanpur, India, some of them named *G. barbadense*. In the British Museum Herbarium there are specimens collected in Florida in 1853 by Structer, and another from St. Louis on the Missouri, collected by Drummond in 1832. In M. de Candolle's Herbarium, Geneva, there is Thonning's plant, collected in Guinea, which may possibly be *G. prostratum, Schum. et Thon.* (which see).

In the Herbarium belonging to the Reporter on Economic Products to the Government of India, there are the following: n. 1,804, collected in 1894 at Gondal in Kathiawar; nn. 12,307 and 12,320; lastly a cotton from Singhbum, known as *badi*, cultivated at Sibpur Exp. Farm.

Religious cotton.

Nomenclature.—It is not uncommon to find popular writers affirming that the name *religiosum* was given to denote a cotton cultivated by 'Fakirs' (? *Sádhús*), without their having deigned to consider whether religious mendicants of any creed ever cultivate cotton at all. Seemann says it got the name because of its being used for the yellow dresses of the Buddhist priests, but he also adds 'that there is no authentic specimen of *G. religiosum* in Linnæus' herbarium.' Both statements are most likely incorrect, for in Linn. Herb. there is undoubtedly a sheet on which Linnæus himself wrote '*religiosum*' **(see Plate No. 32 A)**. But taking the wider and more probable signification, namely of plants grown near temples or plants the wool of which is employed by the Brahmans, then the *religiosum* of the Hindus would be the *Deo kapas* or *Ram kapas* (*G. arboreum*). In modern usage, however, almost any perennial or tree cotton has come to be viewed as the religious cotton, hence very largely the confusion of *G. brasiliense* with the present plant. I cannot say that I personally have ever seen a tree-cotton growing near a temple in India: the statement seems to have originated with Royle, and to have been customarily repeated without verification.

But we have to deal, not with what might be called 'the religious cotton,' but with determining the plant to which Linnæus in the 'Systema Naturæ' meant to assign the name *G. religiosum* specifically. It had leaves 3-lobed (if we exclude the synonym of Plukenet which Linnæus himself was doubtful about), and it came from the Indies. By the time Linnæus wrote the 'Systema' we are justified in thinking he had begun to describe actual plants known to him (not to correlate the writings of the early botanists), hence the specimen in his Herbarium (above indicated), which is, by the way, not numbered in the series of the 'Species Plantarum,' may therefore

No. 33. GOSSYPIUM HIRSUTUM, *LINN.* VAR. RELIGIOSA, *WATT.*

Photographic reproduction of the Kew Gardens copy of Roxburgh's original MS. illustration named "1497 Gossypium fuscum, R." ; preserved in the Herbarium Library, Royal Botanic Gardens, Calcutta.

be accepted as the type of this form. It was named in Linnæus' handwriting '*religiosum*,' but corrected by Sir James Smith into '*barbadense*,' an idea of his own for which there is no authority. In this view of the case there can be no manner of doubt that the specimen of *religiosum* that must be accepted as the type of the species, is more closely related to *G. hirsutum* than to *G. brasiliense* (which is Plukenet's plant with 5-lobed leaves and kidneyed seeds). Lamarck had a fairly correct conception of what Linnæus meant, hence his allusion to *G. religiosum* under his *G. tricuspidatum* and the exclusion of the synonymy. Cavanilles followed Lamarck, but urged that the protrusion of the style and stigma, before the complete expansion of the white flower, were distinctive features. His plate is a very unsatisfactory one, and his statement that it came from the Cape of Good Hope is interesting, more especially if the view be accepted of regarding this plant as a cultivated state of *G. prostratum, Sch. et Thon.*

Linnean specimen.

Cavanilles' definition.

Poiret (*l.c.*), following Lamarck, gave a good account of it, and Turpin (*l.c.*) furnished a fair drawing. Unfortunately, however, Poiret seems to have been compiling, and accordingly fell into several errors, such as the description of the leaves as glabrous, though the young shoots were hairy. The wool, he says, is fine and very white, but firmly adherent to the seed. He then observes that it approaches closely to *G. latifolium, Murray* (and in that opinion he is undoubtedly correct), but concludes that the plant, though cultivated in the East Indies, was originally a native of the Antilles. There would seem no doubt whatever that the present species (if the suggestion regarding *G. prostratum* cannot be upheld) is purely and simply a cultivated state, but where or how it originated no one hitherto seems to have made any effort to ascertain.

A cultivated state.

Both Swartz and Willdenow, followed by Parlatore, completely confused it with *G. brasiliense*. Buchanan-Hamilton, who reduced all the cottons of the world to two species—the white-seeded and the black-seeded—nevertheless fell into the error of adding a third (*G. croceum*) to denote those with red-coloured wool, the most striking manifestation of which he, no doubt, regarded as the present plant. He thus destroyed his classification or exposed its utter futility. Roxburgh was the first author who seems to have carefully studied this form, and he remarked that it 'can scarcely be more than a variety of *hirsutum*.' He describes the seeds as 'free, clothed with firmly adhering, short, tawny down, and long wool of the same

Red or *khaki* cottons.

Roxburgh's view.

colour.' Roxburgh tells us that it was introduced into Bengal under the name Nankeen cotton, but adds that 'more recently a small variety of this tawny cotton has been introduced into this garden from the province of Nankeen itself.' The small plant to which Roxburgh alludes was doubtless *G. Nanking*, and thus the father of Indian botany had early recognised that the wool being red or *khaki* coloured was in no way specific, and moreover that the true *khaki* cotton of China was not *G. religiosum*, and thus without so much as naming it, swept *G. croceum* from the literature of the genus.

Bombax religiosum.

In conclusion it may be pointed out that Linnæus was in error when he cited Plukenet ('Alm.' 172, t. 188, f. 2), under his *Bombax religiosum*, 'Sp. Pl.' (ed. 1753, 512). In the subsequent edition, Linnæus himself omitted that citation, but it was possibly due to this error that Plukenet's illustration came to be spoken of as *G. religiosum*, and that the further error was made by Swartz, Willdenow, and Parlatore, of calling the kidney cotton of Brazil *G. religiosum* (the plant actually described and illustrated by Plukenet's f. 2). The species which Linnæus himself distinguished by that name is the form discussed above as *G. hirsutum, Linn., var. religiosa.*

30. G. PALMERII, *sp. nov.*

Leaves mostly linear oblong, pinnately veined, bracteoles very slightly united below and having conspicuous cavernous glands on the apex of the pedicels and within the cordate bases of the bracteoles, also minute bractlets occasionally present, protecting the internal glands (f. 3); flowers very small, pale yellow; seeds large, free, coated with green fuzz and silky cotton. **(See Plate No. 34.)**

Description.

A much branched woody shrub, all parts glabrescent, stems, branches and petioles quite glabrous, dark red and wrinkled, internodes often very short, especially on the flowering shoots, joints conspicuous and marked by large scars corresponding with the attachments of the stipules. *Leaves* 1 to 3½ inches long by ½ inch broad, almost quite glabrous except a few shaggy hairs on the margin, mostly entire, linear-oblong, slightly constricted below into the obtuse or imperfectly cordate (simulating an auriculately peltate) base, acuminate and bristle tipped (f. 1), pinnately 1-nerved or only imperfectly 3-nerved and with a conspicuous gland ¼ inch or so from the base (f. 2), occasionally 3-lobed, the lobes long, narrow, and cut almost to the bottom, but with the auriculately peltate condition of base prolonged beyond the union of the three veins; *stipules* large, broad ovate acuminate, caducous, leaving the scars already mentioned (f. 1). **Inflorescence** lateral branched shoots, with very short jointed or gnarled divisions; *peduncles* not half inch; *bracteoles* very slightly united below, ovate deeply

M. Smith delt, J. N. Fitch lith.

West, Newman imp.

No. 34. GOSSYPIUM PALMERII, *WATT.*

1, Flowering perennial branch; 2, portion of leaf showing gland; 3, bud and calyx with (*a*) bractlet (slightly enlarged); 4, ripe fruit; 5, seed with fuzz and floss.

cordate, acuminate, with three to five very long awl-shaped teeth, glands on extremity of peduncle forming conspicuous pits within the auricles of the bracteoles. *Flowers* very small, scarcely one inch in length and corolla only slightly exceeding the teeth of the bracteoles. *Corolla* pale lemon yellow conspicuously black-dotted, petals ciliate and with a purple tinge on the blades, but destitute of purple blotches on the claws; rotating to right. *Calyx* (f. 3) glabrous conspicuous, loose truncate, many-veined, with black dots (glands) in parallel rows; *fruit* (f. 4) contained within the accrescent bracteoles (less than one inch in length), ovate oblong, suddenly and shortly beaked, warted on the outer surface, bursting into three valves. *Seeds*, three to four in each cell, free, large, irregularly triangular in transverse section, densely coated with green fuzz and with a fairly liberal supply of woolly white floss (f. 5).

Habitat.—Mexico. Mexico.

Citation of Specimens.—Collected by Dr. Edward Palmer, n. 384.

Nomenclature.—Dr. Palmer issued specimens of this plant under the name *G. arboreum, Linn.*, which species it resembles in the possession of a green fuzz, but in almost no other feature. It has, however, a close affinity to *G. fruticulosum, Tod.*, although Todaro describes his species as having the leaves all simple and obscurely sub-cordate; makes no mention of the peltate condition of the base of the leaf, nor of the prominent stipular scars, nor of the pits on the apex of the pedicels, neither had he seen the fruits and seeds. It accordingly seems desirable, in the present state of our knowledge, to assign an independent position to Palmer's plant rather than to modify the description of *G. fruticulosum* so as to embrace the two forms. This is the more desirable since a specimen in the Herbarium of Florence, named by Todaro himself as *G. microcarpum*, is hardly the *G. microcarpum* figured and described by him, but is in my opinion rather suggestive of *G. fruticulosum*, and would thus be a cultivated state of that species or of *G. Palmerii*, in which case all three specimens may constitute but one species. But the fact that Todaro described a very different looking Mexican plant, *G. lanceolatum*, as a distinct species, which has simple narrow lanceolate cuneate leaves, borne on long petioles, the whole plant in that instance being hairy, allows of the possibility of a third or even of more species—such as *G. Palmerii* and *G. Schottii*. Affinities of the plant.

G. Palmerii has all the appearance of being a wild species—its cultivation (owing to the small size of fruit and low yield of floss) could never be profitable—though the label on the solitary specimen seen by me makes no reference to that fact. It seems this may to A wild species.

Fuzzy versus naked seeds.

some extent be the so-called *G. arboreum* of writers on American cottons, and it is quite possible that it may have contributed by hybridisation toward the production of some of the cultivated plants of the New World, especially those like *G. microcarpum*, *G. peruvianum*, or even *G. hirsutum*, that have fuzzy seeds. Its existence, were there no other evidence, gives a complete refutation to the statement, often made, that the fuzzy-seeded species are of Asiatic and the naked-seeded of American origin.

31. G. FRUTICULOSUM, ***Tod.***, *Rel. Cult. dei. Cot.* (1877–78), 187, *t.* XII., *f.* 3.

Description.

A much branched bushy species, branches slender, corrugated, quite glabrous. *Leaves* small, reticulately rugose, leathery, simple, lanceolate, subpinninerved, base rather obtuse and obscurely sub-cordate acute; *petiole* slender half shorter than the blade; *stipules* broad, semi-ovate. *Bracteoles* joined very slightly together, broad ovate, deeply toothed (to the middle), much longer than the pedicels. *Corolla* small, scarcely equal to the bracteoles. *Capsule* and *seed* not seen.

Todaro's description (of which the above are the more diagnostic features) is hardly sufficient to allow of a definite opinion being formed, but his drawing of necessity involves the retention of the species. It is some years since I had the pleasure of examining the collections preserved in the Herbarium of Florence (Webb's) but of the sample of this plant named by Todaro himself I recorded in my notes that it might be fairly well accepted as the wild condition of *G. microcarpum*.

Mexico.

Habitat.—Mexico.

32. G. SCHOTTII, ***sp. nov.***; *G.? PUBESCENS, Schumann, Mart., Fl. Brazil* (1891), XII., *pt.* III., *p.* 586.

Ancestral types.

Leaves sparsely pilose and almost completely split up into three to five long linear lobes, the central one much the longest, the lowermost pair much the shortest and spreading horizontally; flowers fairly large, longer than the tailed teeth of the free bracteoles, yellow tinged with purple; fruit globose, hardly exceeding the bracteoles; seeds large, irregular, with coarse rust-coloured fuzz and scanty coating of inferior reddish wool. (**Plate No. 35** reproduces a cultivated state that closely approximates to the conditions of the wild plant.)

Leaves occasionally entire, mostly segmented; lobes tapering into a long acuminate apex and constricted into a narrow acute sinus, middle one sometimes with one or more lateral teeth, next pair of medium size and the lowest pair very much shorter and spreading horizontally, base minutely cordate with auricles covering the sinus. *Inflorescence* lateral shoots, bearing two to four flowers, lowermost internode forming a peduncle 2 to 3 inches long, pedicles hardly an inch; *bracteoles* ovate rotund,

No. 35. GOSSYPIUM SCHOTTII, *WATT.*

Cultivated state.

A sport from King's Improved (see Plate No. 31 B); is possibly a hybrid between *G. jamaicense* and *G. Schottii*, showing reversion to latter.

almost quite free, auricled, cut into nine to eleven broad linear suddenly tailed teeth. *Flowers* medium-sized, yellow tinged with purple; *calyx* cup-shaped, with five triangular teeth; *corolla* one-third longer than the bracteoles. *Fruit* 3-celled, almost globose, with a short pointed beak; *seeds* large, irregular, coated with coarse rufous coloured fuzz and scanty supply of inferior reddish wool. In one specimen grown in the Botanic Gardens, Calcutta, the wool is fairly abundant and silky and of a rich red colour.

Habitat.—Collected at Merida in Yucatan. Yucatan.

Citation of Specimens.—Yucatan, Schott, collected in 1865, n. 602; Paraguay, Hassler, n. 484, collected in 1897. These specimens are in the British Museum, but from the Calcutta Herbarium I have been shown a specimen of this little known plant which is said by Kurz to have been grown in the Royal Botanic Gardens. Specimens.

Nomenclature.—I may not be correct in treating *G. pubescens, Schum.*, as a synonym for this species. It is, however, in that case still another member of the present sub-group of fuzzy seeded cottons. The entire calyx, dark purple corolla and brownish fuzz, would carry it nearer to *G. Schottii* than to *G. microcarpum*, though it is probably an intermediate form, hence I have not ventured to give Brazil as a habitat for either of the plants here mentioned. Hassler's specimen from Paraguay might almost be spoken of as giving the link of transition into *G. microcarpum*, though it is distinctly nearer to *G. Schottii*. Similarly the specimen in the Calcutta Herbarium affords the transition into the glabrous *G. Palmerii*. My chief purpose is, however, served by drawing attention to what stands every chance of being a Brazilian member of this curiously interesting series of cottons. Stephens ('Rambles in Yucatan') speaks of wild cotton plants.

G. Schottii as defined by me above must of necessity be a wild plant, since its inferior grade and low yield of wool would never justify its cultivation. It, however, matches sufficiently closely a hybrid found in a field of King's Improved cotton at Richmond, Va. (recently sent to me by Mr. Lyster H. Dewey of the Bureau of Plant Industry in the United States of America), as to countenance the belief that the so-called sport in question may have originated through the hybridisation of *G. punctatum* or of *G. hirsutum* with the present species. The specimen came to me under the vernacular name of *okra*—a name that it will be recollected had on a former occasion been given to an American sample of *G. arboreum, var. neglecta*. It is suggestive of the West Indian name *ochro* (*Hibiscus esculentus*) and possibly thus denotes the deeply dissected condition of the King's Improved cotton. Okra cotton.

leaves. From the remark on the attached label of the present specimen it may be inferred that the American authorities were induced to believe that, though widely different from King's Improved, it was perhaps but a natural sport. 'Thousands of plants were grown from the seed, and but very few reverted to the broad leaf type.'

Abrupt changes.

Cook ('Weevil-Resisting Adaptations of the Cotton Plant, 1906,' p. 70) alludes to this *okra* as an ordinary example of 'abrupt changes or sports; also called mutations, saltations, and discontinuous variations. These are represented in cotton by the occasional appearance of a plant with brown lint, deeply divided leaves (*okra* cotton) or very short branches (cluster cotton).' In a foot-note he continues: 'Some may be inclined to interpret these as reversions and to argue that the deeply divided involucral leaves may be a reminiscence of an ancestral character of the cotton.' Quite so: and surely there is as great a danger in the conception of selective development being carried to an unwarrantable extent, as in the theory of hybridisation with its concomitant reversions (or recessive manifestations) being over-done. The picking and choosing of evidence in support of theories is ever a dangerous procedure. But there would seem certain facts that cannot be neglected, such as the following: no truly wild species has yet been discovered possessed of a pure white fuzz and floss—the undoubted wild forms have red or rust coloured flosses. In neglected cultivation, red cottons constantly appear with any and every known species of *Gossypium*, but immediately these are placed under special cultivation, the coloured floss disappears and the white one reappears. The red floss can hardly, therefore, be other than an ancestral character. There is, moreover, the geographical consideration. A group of undoubted wild species exists in Central America, possessed of certain characteristics. From that very country, as a matter of history, there have originated certain cultivated stocks which show many close affinities to their associated wild species. If selective development be made to alone account for all this, then there very possibly is but one species of *Gossypium* in the world. But how about the wild species—are they all mere climatological adaptations?

Choosing of evidence.

Ancestral types.

So again the fact that, when two or more forms of cotton are grown side by side, crosses almost invariably occur (see hybrids of *G. hirsutum*, p. 193), which leads to the belief that their hybridisation might almost be viewed as a case of opportunity rather than of suitability.

Accordingly there would seem nothing to be surprised at, in reversions (or recessive manifestations) being more frequent than variations and sports. But to return to the *okra* cotton. The bulk of the Upland American stock of present day cultivation might be described, and accurately so, as consisting of forms of *G. mexicanum*. We read that repeated fresh supplies of seed have been procured direct from Mexico. It would thus be no great stretch of imagination to assume the possibility of hybridisation of the cultivated stock of Mexico with the Yucatan *G. Schottii* or some other allied form. Hence it is quite probable that King's Improved may itself be a hybrid of this nature, the split-leaved plant which appeared as if a saltatory variation being a recessive manifestation of the *G. Schottii* characteristics. It is equally possible, however, that the fresh seed, imported from Mexico, may have been mixed and that the split-leaved plant had survived in the States for some years (and even got hybridised there), before its presence was recognised, just as the 'Hindi weed cotton' of Egypt is reproduced year after year. In fact it might be possible to be a cultivated state of *G. Schottii* in which no hybridisation existed whatever, a weed of not sufficient importance to attract attention, which once mixed, the seeds could not very readily be picked out from the supply reserved for future sowings.

Recessive manifestation.

I take the liberty of reproducing photographically the sample of this interesting split-leaved cotton (**See Plate No. 35**) since it can fairly well be accepted as a cultivated state of *G. Schottii*—a plant collected originally in Yucatan, some forty years prior to this reference to its existence as a cultivated species. (Cf. with the remarks below on Uplands p. 233.)

Cultivated state.

But the interest in this split-leaved cotton is not confined to the present instance. Todaro, it will be recollected, indicated two species of ? wild cottons, namely *G. fruticulosum* and *G. lanceolatum*, found by roadsides in Mexico. These plants, and the two additional forms here described, constitute a closely allied group of Central American cottons, with free bracteoles, and fuzzy seeds, that maintains to the more highly prized New World staples an exactly parallel relationship with the Asiatic and African groups, having united bracteoles and fuzzy seeds. Lastly Todaro's *G. microcarpum* (of which mention has already been made) is perhaps the earliest known cultivated state which with safety can be spoken of as possibly derived in part from this assemblage and which has assumed commercial importance.

The fuzzy seeded cottons.

33. G. **LANCEOLATUM**, *Tod.*, *Rel. Cult. dei Cot.* (1877–8) 185 *t.* v., *f.* 1; *G HIRSUTUM var. β Parl., l.c.* 43; *G. HIRSUTUM VAR. LANCEOLATUM, Aliotta, Riv. Crit. Gen. Goss.* 80.

A herbaceous pilose species with slender diffuse branches. *Leaves* with long branch-like petioles, often longer than the lamina, which are lanceolate, acuminate, uniglandular and pinninerved; *stipules* sagittate. *Bracteoles* large, broad, ovate, rotund, hairy, deeply cordate, joined below by a narrow portion, deeply toothed above, teeth divaricate, tailed, longer than the corolla; capsule and seed not seen.

Is there anything to support Aliotta's suggestion that this is the plant found by Hernandez in Mexico? In the Florence Herbarium (Webb's collections) there is a sample named by Todaro himself of which I have recorded in my notes that it is a very distinct plant with extremely thin, softly hairy, long lanceolate leaves, and the bracteoles longer than the flowers. I am thus led to believe that, accepting the drawing furnished by the author as denoting the type, this plant must be viewed as distinct from *G. Schottii.*

Habitat.—Mexico, growing by roadsides.

34. G. **MICROCARPUM**, *Tod.*, *Hort. Bot. Pan.* (1876), *Vol.* I., *p.* 63, *t.* 14, *also Relaz. Cult. dei Cot.* (1877) *p.* 181, *t.* XI. *f.* 16; *? Nigro Cotton, Labat, Nouv. Rel. de l'Afrique Occ.* 1728, *vol.* III., *pp.* 262–9 *t.* 261; *Porto Rico, Rohr., Cult. du Cot. &c.* 1807, *pp.* 11, 64–7; *G. CONGESTUM, Miers, MS. in B.M.; Ica Cotton, Spruce, Cult. Cotton in N. Peru*, 1864, *p.* 63–4; *G. PERUVIANUM, Welw., Cat. Af. Pl. pt.* I. *Hiern*, 1896, *p.* 78.

The Ashmouni Cotton of certain writers; Red Peruvian Cotton.

Description. Leaves pilose and ciliate, deeply cordate, palmate, lobes 5 or only 3, narrow linear (**f. 1**); flowers thick, tomentose, often scarcely exceeding the bracteoles, which are nearly free to the base; calyx very large, wide, prominently 5-toothed; fruit small, rotund to ovate acuminate (**f. 3**); seeds semi-conglomerated (**f. 3**), large, coarse, partially coated with a greenish or rufous coloured fuzz (**f. 4**) and dirty white coarse harsh wool. **(See Plate No. 36.)**

A detailed description may help to more fully isolate this species from *G. brasiliense* and *G. peruvianum*:—*Stem* round angled, purple coloured, gland-warted, but otherwise quite glabrous. *Leaves* thick, leathery, sub-glabrous above, pilose-tomentose below, ovate, sub-rotund cordate, 3–5 or 7, palmisectly (sometimes almost pedatisectly) lobed, lobes ovate, linear, acute, the lower pair spreading at right angles to the petiole, the others ascending (as in *G. vitifolium*, to which in certain respects this plant has a close affinity), a gland on one to three of the chief veins below, nerves and veins very prominent; *stipules* large, persistent, linear lanceolate. *Inflorescence* strong, rigid, one to two flowered lateral shoots, peduncle flattened and angled, bearing one or two 3-lobed leaves; *bracteoles* glabrous, very large,

M. Smith delt, J. N. Fitch lith.

West, Newman imp.

No. 36. GOSSYPIUM MICROCARPUM, *TOD.*

1, Flowering shoot with ripening fruit and flower, calyx of latter revealed in order to manifest its relatively large size; 2, ripe fruit with its sharply reflexed tips of the valves; 3, mass of three seeds conglomerated; 4, separate seed showing tuft and band of fuzz.

broad ovate obtuse, deeply cordate, the auricles slightly united, deeply laciniate, the teeth tailed, warted and ciliate; *peduncle* with obscure glands on the extremity placed within the auricle of each of the bracteoles, but none on the calyx. *Flowers* large, thick, massive, pale yellow, and without purple spots, campanulate when fully expanded; *corolla* a little exceeding the bracteoles, tomentose on the outer surface; *calyx* very large, with five broad ovate deltoid teeth, quite glabrous. *Fruit* sub-rotund, acuminate, 3-celled, and tips of valves reflexed (f. 2), contained within the accrescent bracteoles; *seeds* large, partly adhering together and with an imperfect rusty or greenish brown fuzz below the woolly floss.

Habitat.—Specimens from Mexico, Peru, Brazil, Africa, Malaya, etc. It is the 'Porto Rico' cotton of Rohr. Probably originated in Mexico. Mexico and Peru.

Citation of Specimens.—The type specimen of this species, as figured and described by Todaro, was, it would appear, raised at Palermo from seed said to have been procured from Mexico. Specimens.

In the Herbarium of Florence there are two specimens of presumably this plant, named by Todaro himself, as *G. herbaceum, var. microcarpum.* The plant was said to have been grown at Palermo, but Parlatore corrected the determination into *G. arboreum.* It might once more be changed, however, into a wild condition of *G. microcarpum* if not into *G. Palmerii*; it is certainly not *G. arboreum.* Then, in the Naples Herbarium there are three or four more specimens of a slightly larger plant with the leaves sometimes 5-lobed but otherwise identical with the specimens in Florence. In fact they might with safety be spoken of as cultivated manifestations of the selfsame plant. These specimens Todaro, however, named *G. microcarpum*, presumably having by then considered it desirable to separate the plant in question (and very necessarily so) from *G. herbaceum.* It is thus probable that these samples in the Naples Herbarium are the types of the species subsequently figured and described by Todaro ('Hort. Bot. Pan.' 1876, vol. I., p. 63 t. 14).

In the Herbarium of the Royal Botanic Gardens, Kew, there are a few plants that undoubtedly belong to Todaro's species. These are as follows:— From East Central Africa, Zambesi Expedition (collected by Sir J. Kirk, who calls it Pernambuco cotton, and says it was found cultivated by the Makonde people on the Rovuma, 80 miles inland); Nyassaland (contributed by Sir Harry H. Johnston, found at an altitude of from 2,500 to 3,500 feet); Portuguese Nyassaland (collected by Rev. W. P. Johnson); Dr. Busse n. 184, from East Africa (seeds almost quite naked and free); Austro-Africa, H. A. Junod, n. 658; from N. W. Africa: Angola (collected by Welw., n. 5,229); from N. Africa: Canaries, Teneriffe, 1846 (ex herb. J. Gay); Socotra (collected by Professor B. Balfour, n. 707 of 1880); Bahr-el-Ghazal (collected by Mr. H. Brown from the Experimental Farm Wan, where, it is called mit afifi Cotton; from Malaya: Philippines (Vidal, n. 2,183, said to be wild and called *Gapas*). There is no specimen from the New World in any Herbarium examined by me. Abundance in Africa.

This plant is not represented in the Sloane Herbarium of the British Museum—a fact that may perhaps argue for a recent introduction into

general cultivation. In fact there are remarkably few specimens of it in the general Herbarium, and no examples among the selections of specimens sent for my inspection from De Candolle's Herbarium, Geneva, the Cambridge Herbarium, the Edinburgh Herbarium, or the Calcutta Herbarium. Mr. Lawrence Balls has supplied me with one plant from Egypt that seems likely to be an example, though it certainly is not pure. This is numbered 207–2, and seems a cross between this species and *G. mexicanum*. It has the wool of a rusty colour, and on that account alone apparently, the name Nankin cotton had been suggested for it. Mr. Broun has recently sent me a specimen, under the name '*Ashmouni* Cotton,' a somewhat remarkable fact, since by most writers *ashmouni* is said to have a naked seed.

Thus in conclusion it may be said that, judged of by the specimens seen by me, the persistence of this species in its association with Africa, in place of Mexico, (the country of its supposed origin) is to say the least of it, most significant.

Nomenclature.—This somewhat remarkable plant might be accepted as a form of *G. peruvianum* but for the leaves being more deeply palmiparted and the seeds more or less united together in kidney fashion. But that it is not *G. brasiliense* may be at once accepted from the circumstance that the peculiarities of leaf, bracteole, flower and calyx, above narrated, are never met with except in association with a velvety seed. Todaro regarded it as a Mexican plant, but Spruce (*l.c.*) speaks of it as specially grown in the Ica valley of Peru; as represented in Herbaria it would appear to be more especially abundant in Africa.

Negro cotton of Senegal.

The prevalence of examples of this plant from Africa lends countenance in fact to the belief that many of the cottons spoken of by African travellers, who have omitted to give descriptions sufficient to allow of determinations, may nevertheless have denoted this plant. Thus Labat, speaking of Senegal (1728) mentions an arboreous negro cotton seen by him that is not cut down in the fashion mentioned in connection with Guadeloupe (see *G. vitifolium*) and to this circumstance he thinks is due the fact that the Senegal cotton is thicker, shorter and less valuable than that of Guadeloupe, and resembles that of the Levant. The leaves of the Senegal plant he says are softly hairy and deeply cut into five parts, like a vine, only smaller. The flowers are commonly in the axils of the leaf-stalks, and are pale yellow with reddish border and streaked with purple. An arboreous species with yellow flowers tinged with purple, with five-lobed leaves, and which bears a coarse thick wool, is a description that would suit this species better than any other known to me. It is therefore, very possibly, the earliest mention of the plant.

This species undoubtedly belongs to a group of cottons that, so far as at present known, are peculiar to Mexico and Yucatan, some of which are indigenous to these countries. The probability is, accordingly, in favour of Todaro's statement that it is a native of Mexico, or at all events originated very possibly in Central America, but the existence of an extensive assortment of specimens collected in Africa shows that its cultivation must be fairly ancient, seeing that it had got distributed so widely, long anterior to its recognition botanically. Miers (MS. notes preserved in B. M.) speaks of his *G. congestum* as being found in the Antilles and Brazil, and Spruce undoubtedly is speaking of this plant in connection with Peru. It is unfortunate that Todaro was not aware that Miers had studied the plant and suggested a good name for it. Origin.

There seems little doubt that Rohr's 'Porto Rico' cotton is not the naked-seeded Porto Rico cotton of Poiret, hence if it cannot be accepted, in the future, as a good species it is highly probable that it may be found to be a hybrid produced possibly from *G. peruvianum* hybridised by *G. Schottii* or some other member of the fuzzy seeded cottons to which the present form also belongs, see p. 335. Porto Rico cottons.

Cook ('Weevil-Resisting Adaptations &c.') seems to incline to the belief that the reduced size of the calyx, in *Gossypium*, relatively to the corolla, is in some way dependent on the presence of the protection afforded by the bracteoles. But in this species, where the calyx is exceedingly large, the bracteoles are also exceptionally well developed.

Cultivation.—Spruce (*l.c.*) is the only writer, so far as I can discover, who has furnished practical facts regarding the cultivation of this plant. He remarks that the contents of a three-celled capsule weighed 125 grains—viz. 31 seeds or 65 grs.; cotton 60 grs., or 48 per cent. of gross weight. He continues, 'this produces the largest pods, with the most numerous seeds, and consequently the greatest quantity of cotton in each cell, of all the kinds of cotton cultivated in Peru.' From the figures given it would take not quite 120 pods to yield a pound weight of clean cotton.

35. G. PERUVIANUM, *Cav.*, *Diss.* (1785-90), 313, *t.* 168; *Green Seed Cotton, Edwards, Hist. Br. Col. in the West Ind.*, 1793, *vol.* II., *p.* 269; *G. PERUVIANUM, Willd., in Linn. Sp. Pl., 4th, ed.*, 1800, III., *pt.* I., 806; *Poiret, in Lam., Encyc. Supp.* II., 1811, 369; *G. VITIFOLIUM, Roxb., Fl. Ind.* III., 186; *G. RELIGIOSUM, Parl., in part*

(*non Linn.*), *Sp. dei Cot.* 1886, *p.* 55; *Imbabura Cotton, Spruce, Cult. Cot. N. Peru,* 1864, *pp.* 67–8; *G. BARBADENSE, Oliver* (*in part*), *Fl. Trop. Af.*, 1868, I., 210: (*? G. hirsutum, Cook, Weevil-Resisting Adapt. of the Cotton Plant, U.S. Dept. Agri. Plant. Indust. Bull. n.* 88, 1906, *p.* 8).

South American, Peruvian (Imbabura) or Andes cottons; it would, moreover, appear probable that this, and not *G. brasiliense*, is the true Pernambuco cotton. Many of the Egyptian cottons are races or hybrids of this species, such as the *Ashmouni, Mit Afifi, Zafiri* and *Abassi*; it seems, however, probable that the *Ashmouni* of some writers is *G. microcarpum*. Certain African specimens examined by me show, on the attached labels, local names such as *Owu*, Abbeokuta; *Ukoko*, Congo; *Bazazulu*, Zambesi.

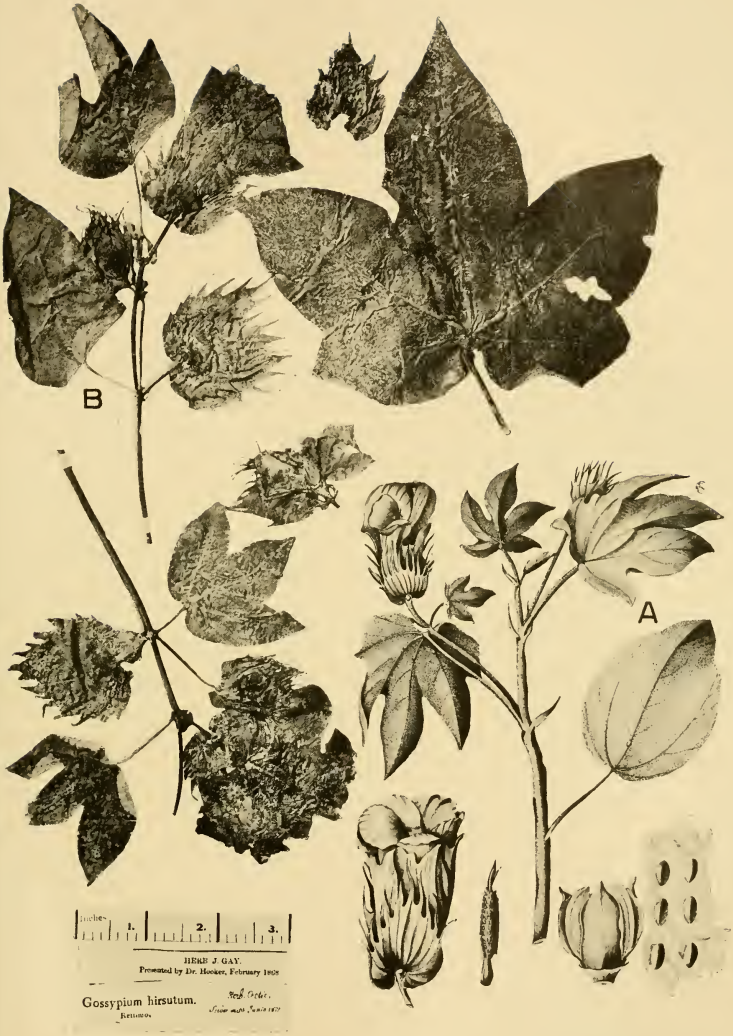
Description.

A bushy perennial with twigs very long and flexuose, strongly angled, striated, ash-coloured with age, stems variegated through abundance of gland dots; leaves often tomentose below, half or three quarters segmented into oblong mucronate lobes; flowers often large, calyx loose, obscurely toothed (**f. 1**); seeds large, free, with a distinct (sometimes imperfect) green, grey or rust-coloured fuzz (**f. 4**) and copious, often silky, wool (**f. 5**). (**See Plates Nos. 37 & 38.**)

Leaves usually densely tomentose below, (when old only pilose) especially on the veins, large, thick, coarse, ovate cordate, entire on the lower parts of the bush, or (f. 1) segmented into five near the middle (f. 2) and three lobes on the top of the shoots, the lobes broad oblong, the three chief nerves (or middle nerve only) with a gland on the under surface; *stipules* very large, broad oblong; petiole about two inches long, with tufts of pubescence growing on the prominent granular dots. *Inflorescence* elongated leaf shoots with generally solitary extra axillary flowers; *bracteoles* with six distinct glands, three inside and three outside, large cordate auriculate, free from each other, adherent to the calyx tube, with numerous raised parallel nerves, incised, the central tooth very prominent and larger than the others; *corolla* often almost tomentose, frequently nearly half as long again as the bracteoles, sulphur-yellow with purple claws drying in the herb into a lemon-green colour; *calyx* loose, obscurely toothed or angled; fruit ovate oblong, suddenly acuminate, three valved (f. 3) scarcely protruding beyond the accrescent bracteoles; *seeds* large, free from each other and with a distinct (sometimes only imperfect) grey, rufous or green fuzz below the copious harsh wool. (Cavanilles describes the seeds as 'black,' and says nothing about a fuzz, and his drawing presumably shows them naked.)

South America and Egypt.

Habitat.—Central and South America (possibly originally indigenous to the Equatorial Andes) but now met with under cultivation in most cotton-growing countries; is especially abundant in Africa, and is apparently the original stock of the *ashmouni, abassi* and



No. 37. GOSSYPIUM PERUVIANUM, *CAV.*

(A) Reproduces Cavanilles' original plate (Diss. t. 168); (B) shows a typical specimen from Herb. J. Gay.

mit afifi cottons, the first mentioned being the oldest of these special Egyptian races. Miers in MS. note in British Museum records gathering this plant at Lima in Peru, and Spruce (*l.c.*) furnished a most instructive account of its cultivation in N. Peru. Spruce incorrectly supposed the name *G. peruvianum* to have been given by Linnæus to the kidney cotton of Brazil, then he adds 'I must confess, however, that I have perhaps nowhere seen a cotton plant truly wild. In ravines running down to the sea at Chanduy and St. Elena, there are a few stunted cotton bushes, which are leafless a great part of the year or sometimes for years together; but, although they look wild enough, they may have been derived from seeds of the plants which the Indians grow near their houses in the adjacent villages, and render productive by constant watering. The cottons grown by the Indians of the Amazon valley are varieties of *G. barbadense*, and so are those of Andine valleys, where there is no tradition of the plant having been introduced; and yet a truly wild specimen is nowhere to be met with.' It was most fortunate, however, that Spruce preserved specimens of the Chanduy plant n. 6541 seen by him in a semi-wild condition, since that removes any possible doubt as to the determination of the species. It was *G. peruvianum*, *Cav.*, as here understood.

Citation of Specimens.—The following are some of the more striking examples of this plant examined by me:—In the Herbarium Royal Botanic Gardens, Kew:—EUROPE: cultivated in Greece, Spain &c., ex herb. J. Gay (named *G. hirsutum*, also *G. vitifolium* and Supp. n. 44 named *G. barbadense*); POLYNESIA: Fiji (Seemann's n. 31—an exceptional example with the leaves more deeply segmented and the fruit more elongated than is usual, also n. 32—a peculiar form, named incorrectly 'New Orleans Cotton,' with the leaves thin in texture, pilose, and in shape rather those of *G. vitifolium* than of *G. peruvianum*); AFRICA: (Western), Abbeokuta, Dr. Irving, 1855, n. 1. 'Common (*owu*) cotton'; Congo, Consul Burton, 1863, *ukoko*; Lagos (common cult. cotton, 1859); Niger Exped., Barter, n. 3349; Sierra Leone, (ex herb. Brown, 1859); Gold Coast, W. H. Johnston, 'Culti. and probably introduced many years'; Togo, W. Africa, Warnecke, n. 18; Liberia, Sir H. H. Johnston (20 miles from Karkatown); Ashanti Exped., 1895, Dr. H. A. Cummins, n. 13F; Sir J. Kirk, from Highlands of Batoka, collected during Livingstone's Zambesi Exped. (material too incomplete, but may be rather *G. microcarpum*, *Tod.*) is described as *bazuzulu* cotton; sample from Egypt named *G. vitifolium*, Willd., Bové, n. 317; Kili Makei, Kaessner, B. E. Africa, n. 611; Natal, Dr. W. B. Grant; Somali Coast, W. W. Perry; Egyptian cotton grown at Khartoum, a specimen recently collected by Broun, n. 694—an admirable staple—probably a hybrid; large series of samples specially furnished for this publication by Mr. W. Lawrence Balls, Cairo, of 'Egyptian Cottons,' also of *abassi*, *mit afifi*, &c., all prove races of

Specimens:

African.

Specimens: this species; West Indies: St. Lucia (J. J. Walsh named *G. barbadense*, *Linn., var. integra, Griseb.*; South America: Paraguay (Thos. Morong, n. 978, seeds with imperfect fuzz and leaves resembling *G. microcarpum*); British Guiana (E. F. im Thurn, n. 79—a specimen that closely resembles Seemann's n. 32, and has the twigs, petioles and leaves pilose and pollen-grains very distinctive.

West Indian. In the British Museum Herbarium there are, as usual, several highly instructive historic specimens in addition to some modern collections that amplify the above enumeration. The Sloane Herb. (vol. 6 ff. 55 and 56) are Sloane's own Jamaica specimens of the plant he named *G. brasilianum* ('Hist. Jam.' II. p. 67 *et seq.*), and these prove to be typical examples of the present species—the leaves densely tomentose, as also the flowers and the seeds, sometimes fuzzy, at other times naked, but never united into a kidney mass. Then in Petever's set of specimens (also in the Sloane Herb.) there is (vol. 162 f. 289) a very tomentose plant that I take to be this species. This is included in Petever's special set of Jamaica plants, but the label bears the name Vaillant, and may thus have been procured from the Royal Gardens of Paris. From Jamaica also came W. Wright's n. 40, collected in 1765–77, which curiously matches exactly Sloane's specimen, and thus confirms the conclusion that the tree cotton of Jamaica, a century ago, was not *G. brasiliense* as hitherto supposed.

In the general Herbarium of the Museum there are J. Miers' collections from South America: Lima, n. 1055, Bolivia, n. 7573, Buenos Ayres, n. 1220; New Granada, Voyage J. J. Triana, n. 3138/5286; Costa Rica and Guatemala, F. C. Lehmann, n. 1912; Polynesia: Atoi, Sandwich Islands (named *G. indicum*), Barclay, n. 1248 (cult. in 1837).

American. In the Herbarium, Royal Botanic Gardens, Edinburgh, in addition to duplicates of some of the plants above enumerated there are examples of this plant from:—South America: Spruce, n. 6541 'Pl. Exsic. Æquatoreales, Chanduy, in litore Maris Pacifici'; Paraguay: coll. by Thos. Morong 1888-90, n. 978 (named *G. maritimum, var. polycarpum, Tod*); Bolivia: coll. by Britton and Rusby in 1890, n. 647 (Yunyas), and by the same in 1891, n. 1201 (Cochabamba); Socotra: by Dr. Bayley Balfour (B.C. 5) collected in 1888; and on Garieh Plain, collected during Ogilvie-Grant-Forbes Exped. 1899; West Indies: certain specimens of a plant collected by Dr. Parnell in 1840 at Montego Bay, Jamaica. These match very closely Seemann's n. 32, and are therefore in all probability examples of a remarkable hybrid between *G. peruvianum* and *G. vitifolium*. In shape of leaf, pilose surface and small sharply toothed bracteoles, they closely resemble the latter, but in seed, fuzz and floss, they come very near to the former. I should not be surprised were Seemann's specimens, and the present set, viewed in the future as exemplifying a form sufficiently distinct to justify separate recognition. Lastly there is in Edinburgh a plant collected by Mr. G. F. Scott Elliot, n. 2103, in Madagascar, which I have some difficulty in determining. It looks as if it might be a cross between *G. punctatum* and *G. peruvianum*.

In the Cambridge Herbarium:—A duplicate of Spruce's n. 6541. In the Calcutta Herbarium there is a specimen collected in Madras, and which has been named *G. arboreum* and recorded under Wallich's n. 1875. In the Herbarium R.E.P. Calcutta:—A sample of Egyptian cotton grown at Sibpur;

M. Smith delt, J. N. Fitch lith. West, Newman imp.

No. 38. GOSSYPIUM PERUVIANUM, *CAV.*

1, Flowering shoot, one bracteole removed to reveal the calyx, which compared with that in *G. microcarpum* is comparatively small; 2, a full-sized leaf and little less than natural size; 3, ripe fruit; 4, fuzzy seed a little enlarged; 5, seed natural size with its fuzz and floss; 6, seed of Abassi; 7, seed of Afifi, both

also collected Ahmedabad, n. 1734, and Gondal, n. 1814. In M. de Candolle's Herbarium, Geneva, there are in addition to duplicates of some of the above mentioned plants samples collected by Zollinger in Java, 1857. In the Florence Herbarium there is a series of specimens named by Parlatore as *G. barbadense*, *Linn.*, which I feel fairly certain are *G. peruvianum*, *Cav.* One label bears a note to the effect that the plant was raised from seed received from Brazil.

Nomenclature.—This somewhat obscure species might be said to link together *G. mexicanum and G. brasiliense.* It has the palmisected foliage of the latter with the blistering habit of the twigs and the fuzz-coated seeds of the former. A somewhat parallel association may be viewed as accomplished by the palmatifid *G. hirsutum* through *G. vitifolium* to *G. brasiliense*, indeed all the earlier herbarium samples marked Egyptian Cottons are forms of *G. hirsutum* rather than of *G. peruvianum* (see p. 185).

Fuzzy seeded cottons.

It is significant that all the American and African *cultivated* cottons that possess seeds more or less coated with velvet (e.g. *G. hirsutum*, *G. mexicanum* and *G. peruvianum*) have the leaves pilose, while the forms with sub-glabrous leaves (*G. purpurascens*, *G. vitifolium* and *G. brasiliense*) have the seeds naked (e.g. not possessed of a velvet coating beneath the floss), but in *G. purpurascens* and *G. vitifolium* the seeds are free from each other, and in *G. brasiliense* they are united into kidney-shaped masses.

G. microcarpum might in the same way be spoken of as a transitional form between these two sets. Its leaves are usually even more deeply palmisected than in *G. brasiliense*, and at the same time they are pilose-tomentose, while the seeds are semi-conglomerated and partially coated with fuzz.

These and a few other plants have (and perhaps naturally so) been much confused by writers on this subject.

Cultivation

Peruvian cultivation.

Central and South America.—Few writers have discussed the special properties of this species from the industrial standpoint. Most have contented themselves with furnishing particulars of the South American cottons collectively or of the Brazilian or Peruvian cottons as a whole. Spruce, who studied the cotton cultivation during the time of the great cotton famine, and published in 1864 his little book on 'The Cultivation of Cotton in the Piura and Chira Valleys of Northern Peru,' devoted special attention to the individual merits of the cottons seen by him, from the belief that there might

be originated a greatly extended South American production. He accordingly regarded it as essential to be able to recommend to planters the most hopeful plants that should engage their attention.

Fortunately Spruce (*l.c.* p. 67) not only furnished accurate scientific descriptions, but collected good botanical specimens which were issued to certain herbaria, and are thus available for botanical verification. Of the present species he says, 'This is the common cotton of the Equatoreal Andes, where I have seen it cultivated in sheltered spots up to 8,000 feet. Humboldt, and after him Boussingault, seem to have met with it at a still greater elevation. It is most extensively grown in temperate valleys of the province of Imbabura, between Quito and Pasto.'

Appearance in the field.

'A patch of Imbabura cotton is readily distinguished from other kinds growing near it by the hoary appearance of the tall well-grown plants, and by its showing its clear sulphur flowers and long beaked pods further beyond the involucres than any other kind.' He then remarks that no cotton is handsomer in the month of January, when well hung with pods, just beginning to open and show the fine white cotton, which has the good property of puffing up into a light mass on exposure to the air, instead of remaining hard and knotty as is the case with many cottons.

'The contents of a 3-celled capsule weighed 83 grs., viz. 23 seeds 51 grs., cotton 32 grs., or about 38½ per cent. of gross weight.'

These are the practical results of Spruce's study of *G. peruvianum* cultivation in N. Peru, but he explains that the seed used had been procured from the Andes of Equador, and that the cotton most cultivated around Guayaquil, and there known as *Criollo* or *Creole*, is a small-seeded variety of the Imbabura. In a further passage he explains that 'there had, strictly speaking, never been any *cultivation* of cotton in North Peru—nothing beyond sowing the seed and gathering the crop. The methods now in use at Monte Abierto and at Santa Lucia, near Amotape, are still scarcely more than experiments awaiting the sanction of results.' He then furnishes particulars of the methods pursued at the new plantations,

Irrigation.

and urges the necessity of irrigation, to supply the water, indispensable to successful production. Drought he holds to be the most malign influence of all. He tells us that a Mr. Stirling had described the ancient aqueducts of the Incas, by which the whole valley of Chira had at one time been irrigated, and was then in all probability a great cotton-growing country. He narrates the

maladies and pests to which the crop is liable, summing up that the greatest and most serious of all is the apathy and ignorance of the cultivators, a not unnatural consequence of the *Conquistadores*. 'Some time after the dominion had passed from the Incas to the Spaniards, a decree went forth from Madrid that the inhabitants of Peru proper and Chili should dedicate themselves to mining and agriculture and to the making of wine . . . but might not set up *obrajes* or factories for the weaving and dyeing of cloth.' This action had the result (perhaps contemplated) of destroying the cotton industry. When Peru became free of Spanish rule cotton cultivation was resumed and extended, but is now alone successful where irrigation in some form is possible. These particulars of Peruvian cotton cultivation have been given in this place because of their having a very special bearing on the present species. While other cottons are met with (and in some cases even more abundantly) *G. peruvianum* is essentially the cotton plant of the slopes of the Andes.

Spanish influence.

Egypt.—Poiret (*l.c. infra*) remarks that in Egypt cotton was cultivated for domestic purposes only, thus showing that shortly before the interest aroused by M. Jumel in 1820 cotton was a very subordinate crop indeed. Particulars of Jumel's cotton will be found in the passage presently to be quoted, as also in a further page under *G. brasiliense* (p. 312). But I can find no definite mention of the conveyance of *G. peruvianum* from Peru to Africa and Egypt. The citation of collections, given above, shows that it is cultivated throughout a great part of the countries named, especially Central and Eastern Africa and Upper Egypt. In another passage (p. 166) I have suggested that very possibly this is not a true species botanically, but may have been produced by crossing one or other of the fuzzy-seeded cottons of Central and South America, such as *G. punctatum* with *G. barbadense* or *G. vitifolium*, and in some cases *G. brasiliense*. Accepting that explanation there would be little difficulty in believing that some at least of the special African and Egyptian stocks may have been produced locally, seeing that a form of *G. punctatum* is an abundant indigenous plant from Central Africa to the West Coast and through Nigeria into Upper Egypt.

Hybrids.

I shall not attempt to give detailed information regarding Egyptian cultivation. Numerous reports have from time to time appeared, and are accessible to those interested. Professor George P. Foaden, B.Sc. (U.S. Dept. Agri. Bull. No. 62, pp. 7–42), wrote, what he calls by too modest a title, viz. 'Notes on Egyptian Agricul-

ture,' but which will be found to deal briefly and in a most admirable manner with the rise, growth and present position of the Egyptian cotton industry. Regarding the varieties of the plant grown, Professor Foaden says their origin is lost in obscurity.

Jumel Cotton.—'Previous to the year 1820 an indigenous cotton existed in Egypt, but, as already stated, its cultivation was practically unknown. In that year a variety of ordinary white cotton was brought to Egypt by a Frenchman, M. Jumel, and even its origin is somewhat uncertain. It was, however, probably brought from the Upper Nile regions. In the growth of this cotton the Khedive took great interest, and he compelled cultivators to grow it in several districts. At that time the irrigation of Lower Egypt was greatly modified by the making of deep canals capable of carrying the low summer water of the Nile, and the cultivation of cotton began to assume greater importance. From the year 1825 to 1839 it is said Sea Island cotton was grown regularly in Egypt; and though it is unknown now, old natives occasionally speak of a variety whose name certainly appears to be a corruption of the words "Sea Island." Again it is stated that Peruvian cotton was introduced and grown.'

Irrigation.

Ashmouni.—'All that can be asserted with safety is that out of the varieties existing in the country "*ashmouni*" cotton was evolved and of the varieties at present cultivated in Egypt this is the oldest.' '*Ashmouni* cotton, although at first discovered in the Delta, where its cultivation was at one time general, is now practically confined to Upper Egypt, in the provinces of Beni-Suef, Fayum and Minieh, being watered by the Ibrahimia Canal.' Professor Foaden gives the yield as 1,300 lbs. seed-cotton to the acre and the produce (expressed as English bales of 500 lbs.) as 86,400 bales (the Egyptian bale is equal to about 750 lbs.). He then adds that it differs from other forms of Egyptian in that the seed is 'clean'—that is, it possesses no adhering fibre (pp. 33–4).

Chief variety.

Mit Afifi.—The *mit afifi* Foaden says is undoubtedly the chief variety of cotton in Egypt. It is so called from the name of a village where it was first grown in 1883. 'It constitutes a very high percentage of the total production of the country, and the price at which its fibre is sold forms the basis for that of other varieties. The plant is normal in size, and not so large, generally speaking, as *Jannovitch*. It is averaged as regards the time at which it ripens. *Ashmouni*, grown in upper Egypt, comes into market first. *Abassi*

is probably a little earlier and *jannovitch* a little later than *afifi*.' 'The fibre of the *mit afifi* is brown in colour, long, lustrous, generally very strong and fine to the touch. It attains to a length of $1\frac{3}{8}$ to $1\frac{1}{2}$ inch. There is a great demand for it; in fact it leads the market.' It yields 500 to 600 lbs. clean lint per acre. The bolls are pointed and rather small, and the cotton is easily picked.

Egyptian coloured cotton.

'The origin of *afifi* cotton is doubtful. Some years ago there existed in Egypt a considerable number of varieties which were short-lived, such as *hamouli*, *gallini*, *hindi*, &c. Pure white cotton also existed, but its cultivation was abandoned after the appearance of *afifi*. A variety known as "*Bahmia*" was also somewhat extensively grown for several years, and gave good results on good quality land. It was also replaced by *afifi*. A good variety known as "*hariri*" was first cultivated in the Goddaba district. This was finer even than the variety known as *jannovitch*, which is cultivated at the present time.' 'What is known as "*hindi*" cotton is really the old native variety, and is now unfortunately found in almost every quality of cotton to a greater or less extent. This, of course, causes deterioration in the staple and also reduces the output in ginning.'

'The silky nature of the Egyptian cottons, and the fact that they possess a brown colour probably indicate that they are really of Sea Island origin, but there is no evidence to show whence their deeper coloration than Sea Island arose unless it was by means of a cross with some highly coloured variety such as Peruvian. It has often been suggested in the United States that the peculiar soil conditions of Egypt, the Nile mud, &c., may account for this; but there exists in Egypt a pure white variety, *abassi*, which has now been grown for many years, and there has been no tendency whatever toward the development of any brown coloration, which seems to preclude this idea. Again, previous to the appearance of *afifi*, the common white cotton was grown' (p. 35).

Egyptian white cotton.

Abassi.—'This is the only white cotton now grown in Egypt. It made its appearance about 1891–92. At first it was grown only on large estates, but it gradually increased in favour, though at the present time its cultivation is diminishing. *Afifi* is the general cultivator's cotton, as it were; it is more suited to all conditions, requires less care in picking, and the market is always certain.' 'Abasi, owing to its colour, requires more care in picking. It is said to be more hardy than *afifi*, resisting periods of drought and adverse climatic changes more successfully. In the late summer and

early autumn, fogs which do a great deal of harm are experienced in Egypt, and it is said that *abasi* cotton suffers less than any other variety and is also less affected by cold spells.' 'The first picking of *abasi* is very superior, and sells well; the later gatherings deteriorate and there is small demand for them.' '*Abasi* is rather more difficult to gin, having a tendency to break the knives. The fibre clings to the roller and often comes to the knives again.' 'The best qualities are exported to England and the poorer qualities to all parts of the Continent—a little to Russia' (p. 36).

Egyptian cotton.

Jannovitch.—'This variety, which has been cultivated for about seven years, is the most silky and fine of all Egyptian cottons. It possesses good length, $1\frac{1}{2}$ to $1\frac{5}{8}$ inch, is very fine and stronger than the best qualities of *afifi*. 'The plant is of somewhat coarser growth than the other Egyptian varieties, and is a little later in coming to maturity. The best qualities are grown in the north part of the Delta, near the sea, and where the land generally contains a certain amount of salt. The output in ginning is inferior to both *afifi* and *abasi*.' 'It is chiefly exported to England, but also to America, the north of France and Switzerland; other countries take very little.' 'It is supposed that this variety originated from a cross of good quality *gallini* (of which very little existed at the time in the district) and *afifi*' (p. 37).

'It may be mentioned that Sea Island cotton, when grown in Egypt, produces good quality the first year. The staple is longer even than that grown, on an average, in America, but is more irregular in length and not so strong. During the second and third years there is a general deterioration.'

Properties.

In Egypt it is generally said that at the present time close on $1\frac{1}{2}$ million acres are under the crop. Professor Wyndham R. Dunstan ('Mem. Cotton Cult.' 1904, p. 10) observes the staple averages from 1 to $1\frac{1}{2}$ inches in length, is generally more lustrous and mercerises better than American Upland cottons, and commands a higher price. Sir Vincent Corbett, in his Egyptian estimates, has drawn attention to the fact that, although of recent years the acres of land under cotton had been steadily increasing, the total of the crop had remained stationary and had even diminished. He then adds that it has also been stated on undoubted authority that the quality of the cotton tends to deteriorate. The Khedivial Agricultural Society of Cairo have for some time been engaged on the improvement of stock, and their secretary, Mr. W. Lawrence Balls, has favoured me not only

with samples of the plants presently being cultivated in Egypt, but with the special plants and hybrids produced from these that are under his observation. The following may be given as the chief ideas formed by me through the study of these and other Egyptian cottons.

Special hybrids.

Jumel cotton would appear to have been *G. brasiliense* (which see page 312) and was thus similar to the Nyam Nyam cotton of the Soudan to-day. Peruvianum, Sea Island, and Hindi cottons were experimentally grown side by side with Jumel, with the not unnatural consequence that new forms appeared (hybrids very possibly derived from two or more of these exotics, the first being the *ashmouni*. This is, therefore, as Professor Foaden tells us, the oldest of the special cottons now called Egyptian. In due course there followed the *mit afifi*, and *jannovitch*, &c. The *mit afifi* is generally regarded as one of the best Egyptian cottons, while the *ashmouni* is nowadays almost confined to Upper Egypt, and is the least important of the series. Moreover considerable difference of opinion seems to prevail as to what should be called *ashmouni*. Professor Foaden says the seed is clean, that it has no fuzz, and thus possibly it is a form with a strong strain of *G. brasiliense*. But I have seen more than one example of what has been called *ashmouni* with a large amount of fuzz, and with the leaves, flowers, &c., almost identically the plant named *G. microcarpum*.

From the *mit afifi*, we are told, came the *zafiri*, and that in course of time gave the *abassi*, the last and perhaps the best in point of merit of floss, of the special races. The *gallini* and *jannovitch* cottons appear to be acclimatised forms of Sea Island, but in addition to all these there are several other races that are undoubtedly best assorted under either *G. barbadense* and *G. vitifolium*, without their being supposed to be degenerated states of Sea Island. These, however, take no material position as commercial cottons, and may therefore for the present be disregarded. But from time to time efforts have been made to acclimatise the Upland cottons of America, and accordingly among the samples supplied by Mr. Balls are several of that description. These never seem, however, to have attained a position of importance in Egypt, though they may have helped hybridisation toward the production of some of the special races that are now important and the survival of the 'Hindi Weed,' which often does serious injury to the superior crops by crossing with them, is one of the ultimate expressions of the Upland influence. (Cf. p. 182.)

Acclimatised Sea Island.

Acclimatised Uplands.

Description.

It may now be useful to furnish here the descriptive notes recorded while examining the specimens supplied by Mr. W. Lawrence Balls :—

1. *Afifi or Mit Afifi.*—This seems a hybrid. *Inflorescence* solitary axillary on leafy shoots, the flowers and fruits thrown to one side, as customary with typical examples of *G. peruvianum*; *stipules* large, sickle-shaped; *flowers* lemon yellow, turning purple, not much exceeding the bracteoles; *calyx* glabrous, loose, cup-shaped, obscurely toothed, but prominently gland-dotted, no bractlets seen and extra floral glands not very strongly marked until the fruits form; *capsule* linear acuminate, with prominent imbedded glands within the outer surface, 3-celled, ultimately opening out almost flat, but beak not strongly hooked; *seeds* fairly large, elongated, striped, nearly naked, except a tuft of rufous fuzz on both extremities, floss somewhat woolly, of a brownish-white colour, matted below, and about 1¼ inch long.

2. *Abassi.*—This seems to differ from the *afifi* mainly in the following points :—*Leaves* more often 5-lobed, and in the young shoots tomentose below; *bracteoles* more deeply gashed, the teeth becoming almost awl-shaped. The *pods* are 3-celled, not opening out so much, and beaks of valves sharply hooked; the *seeds* short-broad, quite free and brown-striped smooth naked, except for a tuft of brownish fuzz on the apex and a patch on one side near the base (more abundant than in *afifi*), wool copious, long, fairly silky, and of good white colour.

3. *Egyptian Cotton*—n. 158, C 2. This seems again a superior cotton, and possibly close to the above. It appears to differ from the *abassi* mainly in the *leaves* being more frequently entire or only 3-, rarely 5-lobed, and the lobes broader and tomentose; *seeds* with the beak not hooked, ovate, fuzz at both extremities very small, and at the base forming forked bands; wool white, long, and silky.

4. *Egyptian Cotton*—n. 56, C 2. This again I take to be only another hybrid close to the *abassi* or *mit afifi*. Leaf stalks and shoots seem to be usually succulent, and *leaves* glabrescent 3- to 5-lobed, very much as in *G. brasiliense*; *flowers* small yellow, no bractlets seen; *capsule* 3-celled; *seed* ovate, beak distinctly hooked and split on the apex, quite naked except for a rufous tuft at the base near the hylum, prominently striped black on the smooth brown surface in a fashion strongly suggestive of the seeds of *G. brasiliense*, although quite free.

5. *Egyptian Cotton*—n. 142 A. I see nothing structurally to separate this from the other forms above detailed. The *leaves* are entire or 3-lobed, not 5-lobed, as is ordinarily the case with *abassi*; *flowers* very small and with purple spots, but they show no trace of protecting bractlets over the glands; *seeds* short, swollen, brown with black lines, and with an abortive fuzz at the apex and base; wool somewhat harsh. This, Mr. Balls states, was used as one of the parents in a hybrid (n. 250), the other stock being a form of *G. hirsutum* (n. 43 A 2), which botanically might be said to be nearer Molango than Moqui (n. 209-3). The hybrid (F 1), I observe, has the large coarse, fuzzy seed of its *G. hirsutum* parent, but possesses a fine long silky floss (a recessive character possibly from an ancient ancestor, probably *G. brasiliense* —Jumel stock). It is curious and perhaps valuable that it has shown the property of early maturity, but will this come true in subsequent generations ?

Artificially produced hybrid.

West Indies.—In a useful pamphlet called 'The A. B. C. of Cotton Planting,' issued by the Imperial Department of Agriculture

in the West Indies, the question is asked 'What is Egyptian cotton?' It is answered by the supposition that it may be Sea Island altered by cultivation in Egypt. I believe that view to be a mistake, though I regard Sea Island as itself (like the Egyptian) a hybrid, but one in which it seems possible *G. brasiliense* may have been one of the ancestors. Acclimatised and hybrid forms of Sea Island exist in Egypt, but I believe that species has never shown any indication of modifying into Egyptian, and it certainly has never been a success in Egypt. But the reverse is the case in the West Indies, where Sea Island is a great success and Egyptian apparently a failure. Results in West Indies.

India.—Mr. Fred. Fletcher, shortly after his having joined the Government of Bombay as Deputy Director of Agriculture, recommended that the attempt should be made to grow Egyptian cotton in Sind. He pointed out that with the extension of perennial irrigation it might be possible to sow that cotton as early as March if not even in February, in place of May. The inundation caused by the rise of the Indus does not take place till May, and the winter frost often being severe, these two facts ordinarily limit the cotton cultivation to a short-stapled, rapidly-growing cotton, that can be sown in May and is off the fields by December. After some readjustments of the dates for cleaning the canals, &c., it was arranged that irrigation water might be supplied from February. By this arrangement it was ascertained that ultimately half a million acres of land might become available for Egyptian cotton. Attempts in India.

Experiments were started with *ashmouni*, *mit afifi*, *jannovitch*, and *abassi* races, but it was soon ascertained that the *abassi* was the most suited. Finally the land selected for a large cultivation was at Mirpur Khás, and reviewing the results ultimately obtained Mr. H. S. Lawrence, Director of Land Records and Agriculture, Bombay, says, in his Report, 1904–5 (p. 5), 'If the cultivation in the coming year is equally successful the matter may be said to have left the region of experiment, and an out-turn of not less than 100,000 bales may be expected in the course of a few years.' Subsequent reports mention the fact that fairly large parcels of Egyptian cotton grown in Sind have been sent to England and fetched 9*d.* a pound, as against 10*d.* for the corresponding grade from Egypt itself. The Sind experiment bids fair therefore to be not only a great success, but to be the pattern of many other future endeavours. Mr. Fletcher is of opinion, in fact, that with perennial irrigation accomplished by a dam at Bukkur the potentialities of the Sind Results.

Province of Sind for cotton-growing could not be surpassed even by the United States. (Cf. Major M. T. Lyde, 'Agri. Ledger' No. 9 of 1898.)

A study therefore of the results obtained in all parts of the world with this special South American and Egyptian cotton, leads to the conclusion that it is best suited to dry, hot, upland climates, where it can be supplied with abundant surface irrigation, with hot sunshine during day, and heavy dews by night. It is pre-eminently, therefore, the species best suited to Egypt and Sind. The experiments at present being conducted by Mr. Balls to shorten the period of growth and at the same time lengthen the staple are calculated to prove of the greatest possible value not only to Egypt, but to all countries for which this particular cotton is specially suited.

Cf. Poiret, 'Dict. des Scienc. Nat. XI.,' 1818, p. 39; Bouteron, 'Le Coton d'Egypte,' Brussels, 1895; Jumelle, 'Cult. Colon. Pl. Indust.,' 1901, pp. 1–27.

36. G. MEXICANUM, ***Tod.***, *Relaz. Cult. dei Cot.* 193 *t.* VI., *et* XII., *f.* 32.

Mexican cotton and the bulk of the Upland Americans, &c., &c.

Description.

This plant is often extremely difficult to distinguish from *G. purpurascens* when seen in foliage only, but from the members of the present section it is instantly recognised by its broad, smooth glabrescent leaves, which are entire or 5–7-lobed and veined, the latter radiating and having 1 to 3 glands beneath; peduncle (or naked shoot) much prolonged, but the pedicels remarkably short and bearing relatively very small, pale-coloured flowers, which are almost completely embraced by the exceptionally broad, deeply auricled, almost bijugate, membraneous bracteoles; calyx 5-toothed; seeds large with a dense woolly fuzz, or at times a thin or even but imperfectly formed fuzz (assuming the form of a rufous crown to the seed), and a floss which is white or grey, copious and woolly in texture (**see Plates Nos. 39, 40, 41, 42**).

A shrubby species usually seen to have a few long shaggy hairs on the petioles, pedicels, and veins, but to become glabrous, owing to the peculiarity often seen of throwing off its cuticle (whether naturally or only as a consequence of parasitic action seems uncertain), twigs round and smooth, pale-coloured, usually very obscurely and minutely gland-dotted. *Leaves*, except on the veins, almost quite glabrous, and gland dots of two kinds, one set large, the other very minute or absent, smooth, thin, membraneous, broad ovate, sub-rotund, suddenly acuminate, cordate, prominently auricled, entire or 3- to 5-lobed, lobes broadly ovate triangular, sinus between the lobes often

No. 39. GOSSYPIUM MEXICANUM, *TOD.*

(A) Reproduction of Todaro's original illustration (Relaz. t. VI.)—the type of the species ; (B) portion of specimen in Herb. Ind. Or. Hook. f. & T. T. n. 421, collected in Madras in 1845.

thrown up in folds, leaves broader than long, 3 to 6 inches across, from tip to tip of lateral lobes and 2 to 4 inches from apex of central lobe to cordature of the base; *petiole* very long, 3 to 6 inches, prominent thick round, usually almost glandular curved and pinkish-coloured, with a tuft of hair near the extremity; *veins*, 5 to 7, or even 9, all united together into a flattened and web-footed formation, within the cordature, from which the veins radiate and arch upwards, the central and first pair of laterals having prominent crater-glands below; *stipules* ovate oblong to lanceolate, very large, and more or less persistent. *Inflorescence* in the early stage lateral axillary shoots, that usually consist of a pronounced and rigid internode that may be called the peduncle (as long or longer than the petiole), which bears on its apex a well-formed entire leaf, on a long erect petiole, within its axil, but thrown off to one side, a short pedicel with frequently a nodding flower; sometimes the flowering shoot elongates or becomes, as it were, proliferous, and consists of a second (or even a third) naked internode, each with a well-formed large entire leaf and a small flower; and ultimately the flowers are solitary or clustered in the axils of the leaves of elongating leafy shoots; *bracteoles* broad ovate rotund, deeply auricled, gashed into 7 to 9 long deltoid acuminate, often fimbriated teeth, two bracteoles usually thrown to one side of the flower and the third on the opposite position, thus simulating a bijugate condition; *pedicel* relatively very short, $\frac{1}{2}$ to 1 inch long, thrown acutely to one side or deflected, angled, almost sub-winged through folds extending from the base of the bracteoles, scarcely thickened upwards. *Flowers* small, pale yellow or white, with a pink flush, and sometimes irregular darker coloured small blotches on the claws; *corolla* small, petals obliquely truncate, hardly exceeding the teeth of the bracteoles, minutely gland-dotted and with very short tomentum on the outer margin; *calyx* large, glabrous, many-nerved, cut into 5 large ovate deltoid or rounded teeth. *Fruit* ovate oblong acuminate, 4-5-valved, only partially opening; *seeds* fairly large, ovate acute minutely beaked, with ash-coloured fuzz and copious woolly floss, of a dull white to reddish colour—in some of the states the seed is almost naked, thus coming very close to *G. purpurascens*, but in the more highly cultivated states it is frequently completely coated with fuzz, thus approaching to *G. hirsutum*.

Habitat.—Apparently originally procured from Mexico, but recorded by botanists from India, Africa, West Indies, United States of America, &c., but only recorded as met with under cultivation. From a large assortment of samples recently sent for my inspection by Mr. L. H. Dewey, from the Bureau of Plant Industry of the United States, I am convinced the best Upland cottons would be more correctly described as cultivated states of this plant rather than as forms of *G. hirsutum*. But the botanical name given to these essentially modern cottons is immaterial so long as they are not regarded as absolutely either *G. hirsutum* or *G. mexicanum*. Mexico.

Citation of Specimens.—In the Herbarium of the Royal Botanic Gardens, Kew, there are numerous samples of this plant, such as from ARMENIA: C. Haussknecht; from INDIA: Wall. Cat. No. 1875 (named *G. vitifolium* Specimens.

Lamk.); Herb. Ind. Or. Hook. f. and T.T. n. 421 (near Madras, 1845) Herb. Wight n. 180 (named *G. nigrum, Ham.* β, in Glasgow Herb., but not same as in Kew Herb.—Cf. *G. purpurascens*); from WEST AFRICA: Angola, Welw. n. 5235; Niger Exped. Barter, n. 1184 ('ordinary cultivated kind'); CENTRAL AFRICA: Schweinfurth, n. 527 (named *G. vitifolium, Cav.*), and Dr. E. Vogel, n. 35 (probably a hybrid); Bahr-el-Ghazar (cultivated at Catholic Mission, Kayangos, from seed obtained from Khartoum); E. AFRICA: Abyssinia, ex herb. Tranqueville, n. 266; Lower Shiré Valley, Sir John Kirk (speaks of a cultivated perennial shrub, which appears to be a hybrid of this plant); from WEST INDIES: Herb. Grisebach, n. 19.

In the British Museum Herbarium there are many examples of great interest. In the Sloane Herb. (Beaufort collections, vol. 132, f. 18) there are leaves said to have come from Barbados (? seeds grown at Badminton); specimen in Clifford's Herb. (named '*G. arboreum* 3'). INDIA: Wight, n. 180; Helfer's Bengal specimen, n. 44; JAVA: Horsfield Herb.; AFRICA: Welwitsch, nn. 5,235 and ? 5,222; MADAGASCAR: Boivin, 1854; AMERICA: Mexico, Palmer, n. 10 (1886). In the Cambridge University Herbarium the following may be specially mentioned: Friendly Islands (Tonga) coll. by Mathews, nn. 149 and 150; Ind. Or. Wight Herb., n. 180 (ex herb. Henslow). In the Edinburgh Herbarium: a specimen named *G. indicum*, Griechenland (a form that looks almost as if it were a hybrid of *G. hirsutum* and *G. herbaceum*). In the Herbarium, Royal Botanic Gardens, Calcutta, there is a long series of specimens that fall into this position of which mention may be made, Wight, n. 213; G. Thomson, collected near Madras, 1845; a specimen from Tahiti. In M. de Candolle's Herbarium, Geneva, collected by P. Levy in Nicaragua in 1870 (n. 381), in which the bracteoles are very small and more ovate acute than is ordinarily the case. From the United States of America, Herbarium of Plant Industry, Department of Agriculture, a long series has been most obligingly sent me for inspection. The more interesting will be discussed in a further paragraph (see pp. 231–9). In the Herbarium of R.E.P., Calcutta, there are specimens collected by me at Mangrol, also in Bhavnagar, during explorations conducted in 1894. In Ahmedabad it was found wild in a hedge around a garden (n. 1742).

In every one of the above the indication is given of its being a cultivated plant, or one which has escaped from recent cultivation. In some respects this species recalls the *kekchi* cotton of Guatemala described by Cook, except that the glands do not seem to be ordinarily protected with the structures he names as bractlets.

Affinities of Mexican cotton.

Nomenclature.—The nearest affinities of the Mexican cotton are doubtless *G. hirsutum*, on the one hand, and *G. purpurascens* on the other, but it is quite distinct from either. Roxburgh ('Hort. Beng.' pub. 1814) alludes to it as introduced into India by W. Hamilton in 1804; but subsequently he seems to have confused it with Bourbon cotton (*G. purpurascens*), and gave both plants the botanical name of *G. barbadense, Willd.*, (see 'Fl. Ind., III., p. 187). He further alludes to Mexican cotton apparently, under *G. hirsutum* (grey seeded), while curiously enough his two MS. illustrations (nn. 425

No. 40. GOSSYPIUM MEXICANUM, *TOD.*

Photographic reproduction of the Kew Gardens copy of Roxburgh's original MS. illustration named "1499 Gossypium barbadense, W." ; preserved in the Herbarium Library, Royal Botanic Gardens, Calcutta.

and 1499), named *G. barbadense*, are in reality pictures of *G. mexicanum*, and are thus neither *G. barbadense* nor *G. purpurascens*. I reproduce by three-colour photography one of Roxburgh's pictures of what I take to be this plant in **Plate No. 40.**

In the botanical department of the British Museum there is a long series of MS. coloured drawings also of this plant, prepared apparently at Saharanpur Botanic Gardens, but of these no history exists. It is thus quite evident that Roxburgh, and subsequently the authorities of the Saharanpur Gardens, had grown the true *G. mexicanum* in India. It has moreover often been alluded to by recent Indian authors: see Wight's papers ('Agri. Hort. Soc. of India,' old series, vol. VI., 189–196; VII., 194–215). Dr. Spry, in fact, considered it as specially suited for cultivation in Behar, but there is no record of success hitherto attained anywhere in India.

It is a very distinctive plant, and in recent years (as represented by the Upland cottons) has become perhaps the most important of all stocks. But while every herbarium possesses examples of it I have been unable, as already stated, to discover a record of its having been gathered from a wild or acclimatised source. All the specimens seen by me are stated to have been cultivated plants, and it would not surprise me very greatly were they proved in the future to have originated recently and to be alone maintained under cultivation. They are hybrids derived very possibly from *G. punctatum* or *G. hirsutum* as the one ancestor, crossed with *G. purpurascens* for one series of forms and *G. vitifolium* or *G. barbadense* for another. There are many groups recognised by the growers (which I shall presently discuss), but in general terms these may be assorted into pilose forms, where the *G. hirsutum* element predominates, and into glabrescent states, where the *G. purpurascens* has become the dominant influence. It is the latter group of hybrids that has come to bear the name *G. mexicanum, Tod.* But taking another conception they may be assorted into broad, compact leaved states, as shown in **Plates Nos. 40** and **41,** or more deeply-lobed conditions, as in **Plate No. 42,** the last being due very possibly to a strong strain of *G. barbadense.*

Mutations.

I have on more than one occasion warned my readers that when dealing with highly cultivated forms of cotton it would be most unwise to suppose the existence of definite species, in the more rigid botanical acceptation. Whether this variability be primarily a consequence of hybridisation (as I am strongly disposed to believe may

be the case) or simply a result of environment and selection, is immaterial from the present contention. Variation and mutation are potent factors rendering it unwise to seek for arbitrary restrictions or hard and fast delimitations of species; still we can get no nearer an understanding of the forms of cotton by calling them varieties or races than by designating the more important and more constant manifestations as species.

Recessives.

Historically we know that a fuzzy green-seeded cotton was largely grown in the Southern of the United States of America, and that this was improved gradually by stock procured from Mexico. Whether that improvement was substitution or hybridisation may be an open question, but to shift the location does not make the origin of *G. mexicanum* any easier of comprehension. There is no single wild ancestor that could be supposed to have originated the diversity that exists. Moreover the sudden appearance of the diverse forms (often called 'sports') is to my mind best accounted for by belief in their being recessive manifestations from hybrid stocks.

Cultivation.

Races and Hybrids.—Within the past 20 or 30 years immense progress has been made in the United States of America with the short staple cottons, but it is no longer possible to speak of them with any degree of certainty under definite botanical names. It is, accordingly, the safer course to deal with them collectively, even although a few can hardly be regarded as forms of *G. mexicanum*.

In fact I propose to accept the popular classification, usually given by cotton growers, rather than to attempt a more scientific system, until such time as the species upheld by me are more widely accepted than at present. This will be seen to be the position also taken by Professor Duggar of Alabama, as also by Burkett and Poe ('Cotton,' 1906, pp. 86–92). I shall, therefore, content myself with recording brief descriptive notes, made while examining the special collections furnished for this publication by Mr. Lyster H. Dewey (Botanist in Charge of Fiber Plants in the Bureau of Plant Industry, Washington). In the remarks that follow it will be observed I adopt one convention that may as well be explained, namely, to place foremost the botanical name of the ancestor most strongly simulated in the hybrid and to give the less evident ancestor the second position; thus *hirsutum* × *mexicanum* would mean a hybrid in which the most distinctive eyemarks are those of

No. 41. GOSSYPIUM MEXICANUM, *TOD.*

Mexican Cotton from Durango : perhaps a hybrid stock, with strong strain of the species named.

G. hirsutum; similarly *mexicanum* × *hirsutum* the opposite condition—namely, a hybrid with the *mexicanum* characters strongly marked.

Upland or Short Staple Cottons of America.

I. Mexican Series.—(1) 'Durango,' n. 599, seed procured from Gobiano del Estado de Durango and grown at Washington. A large broad-leaved plant with young parts hairy; bracteoles ciliate, glabrous within, and having the punctations arranged along the veins, bractlets not seen; flowers large, pale yellow, only partially tinged with purple; calyx smooth glabrous, 3-veined, teeth conspicuous deltoid; seeds beaked, large, coarse, with grey-green bearded fuzz and fairly long silky floss (**see Plate No. 41**). A hybrid strongly *G. mexicanum* × *hirsutum*. Short Staple Uplands: Durango.

(2) 'Mexican Cotton,' n. 2. Is a plant with flowers considerably smaller than preceding but bracteoles with very long teeth. Is a hybrid of *G. mexicanum* × *hirsutum*.

(3) 'Molango,' n. 615, seed procured from Esteban Cruz, Tepehuacan Molango, grown at Washington. A much more hairy form than either of the above, leaves broad with lobes short and sinuses thrown up in folds; stipules very large, broad ovate, suddenly awl-shaped; bractlets within and alternating with the bracteoles, occasionally present. A hybrid of *G. hirsutum* approximating closely to *G. punctatum*. Molango.

(4) 'Mexican Cotton' from the 'Secretario de Fomento,' City of Mexico, n. 5. Is a much-branched form with long spreading hairs on the round smooth stems and all the young parts; leaves often quite entire or only angled—the others 3-lobed on the apex; flowers large, tinged with purple; external gland obscure; bracteoles ovate oblong, with the central teeth much longer than the others; bractlets not seen. This comes much nearer *G. hirsutum* than to *G. mexicanum*.

(5) 'Mexican Cotton' from Mexico, n. 6. Leaves large, from 3–7-lobed (much like Durango above), hairy on the very young parts; flowers pale only, faintly tinged with purple; bractlets not observed; seeds large, coarse, coated with woolly white fuzz and fairly abundant floss, somewhat harsh. A hybrid of *G. mexicanum* × *hirsutum*.

II. Cluster Series.—Mr. Lyster H. Dewey, in the communication with which I have been favoured, in explanation of the Jackson's Limbless.

botanical specimens supplied, remarks :—' The semi-cluster and cluster cottons are adapted to rich bottom-lands where the ordinary varieties become too "weedy" in growth, that is, produce large stalks with few bolls. They are grown in the bottom-lands of Georgia and Alabama and in Southern Arkansas. They produce a medium-sized boll with a good percentage of lint, and are productive under favourable conditions. The peculiar cluster characteristic is due to a shortening of the internodes of the primary or fruiting branch. The secondary or sterile branch is not affected. Jackson's Limbless Cotton, sometimes called African Limbless Cotton, which was extensively advertised a few years ago, belongs to this group. It is rarely mentioned now. It was not essentially different from Welborn's Pet, Drake's Cluster, and other standard cluster types that have been cultivated for many years.'

Drake's Cluster.

Chaco.

(6) ' Chaco Cluster ' Cotton from Colonia Benitz, Chaco, Argentina, n. 166 (seeds obtained from Marcus Brioleni), and grown at Waco, Texas. Is a very hairy plant, in this respect strongly of the *hirsutum* type, but the leaves are 3–7-lobed, the lobes broad ovate acuminate, and with 3 to 5 glands on the veins below; inflorescence crowded in the condition figured by Todaro as his *G. maritimum, var. polycarpum*, that is to say a condition in which extra flowers (2, 3 or 4 in place of one) are crowded within the axils of the leaves; seeds small bent angled, fuzz imperfect, floss very woolly. A hybrid cotton *G. hirsutum* × *mexicanum*. (*Cf.* p. 281.)

Welborn's Pet.

(7) ' Welborn's Pet,' obtained from Arkansas. This is a similar form to the last, with very broad, almost glabrescent, leaves; the flowers crowded in the axils; the fruits with thick smooth woody valves that often open out flatly (square across): seeds large, obtuse beaked, fuzz complete, rust-coloured and floss woolly. It is a hybrid of *G. mexicanum* × *? hirsutum*.

Willet's Red Leaf.

III. Semi-Cluster Series.—(8) ' Willet's Red Leaf,' received from N. L. Willet Seed Co., Augusta, Georgia. This very remarkable plant has the branches, leaf-stalks, young leaves and bracteoles of a purple tint; external and internal glands of the flower very conspicuous and naked, that is to say, not protected by bractlets; teeth of the bracteoles very long, narrow, awl-shaped and fimbriated. It is a hybrid with its strongest strain apparently towards *G. mexicanum*, though it would be no surprise to learn that the other ancestor had been *G. purpurascens*. Rohr a century ago described a red-leaved cotton with fuzzy seeds.

IV. Early Small Boll Series.—Dewey (*l.c.*) writes :—'The Early Small Boll varieties mature quickly and are therefore especially adapted to the weevil-infested regions. They yield a medium percentage of rather short lint, ranging from 22 to 28 mm. in length, the bolls weighing from 3·5 to 5 grams. These varieties were formerly grown most extensively in the Carolinas and along the northern border of the cotton belt, but in recent years they have been introduced extensively in Texas, where it has been found that early varieties are more likely to escape damage from the boll-weevil.'

Under this series are usually placed two plants that I think should be kept distinct. These are :—

Parker Cotton.

(9) 'Parker Cotton,' from New Orleans, La. This is a plant with small glabrescent thick smooth 3- to 5-lobed leaves; flowers fairly large, yellow tinged with purple, external and internal floral glands, small, distinct and naked; calyx loose, glabrous, toothed. Seeds short, thick, rounded, fuzz almost confined to a crown of rusty wool; floss scanty, short but somewhat silky. It is a form very near to *G. mexicanum* of the *G. purpurascens* type, and might rather find a place with the Rio Grande cottons of Dugger's classification.

King's Improved.

(10) 'King's Improved,' received from T. J. King, Richmond, Va. Leaves small, glabrescent, 3-lobed; flowers yellow with purple claws; seeds large, coarse, densely coated with grey-white fuzz and short harsh wool. This is a form closely allied to *G. jamaicense*, *Macf.*, but is doubtless a hybrid. **(See Plate No. 31 B** and compare with **27 B.)**

Okra cotton.

(11) 'Okra or Split-leaf.' The record of this remarkable plant is that it appeared in a field of 'King's Improved' cotton, having been discovered by Mr. A. W. Edson in 1903. Thousands of plants were grown from the seed, but very few reverted to the broad leaf type.

It seems highly improbable that this can be what is usually called a 'natural sport.' **(See Plate No. 35** and contrast with its supposed origin **Plate No. 31 B.)** It is true that both plants manifest in the nature of the punctations and hairs something in common. And moreover the leaves in both are very slightly cordate at the base, the ears of the cordature being thrown across the top of the petiole. Still I feel convinced that while these agreements point to a close relationship, the explanation that to my mind meets the case most satisfactorily is that King's Improved is a hybrid of *G. jamaicense* crossed very possibly with *G. Schottii*. The last-mentioned plant belongs to a striking but hitherto little known group of Mexican and South American wild cottons that all possess certain remarkable

characteristics. The leaves are often linear oblong entire, or they are deeply 3-lobed, the lobes tapering lyrate-like into the sinus, the auricles of the base are thrown almost peltately across the top of the petiole. In all these cottons also the seeds are large, coarse, and have a pronounced fuzz and scanty supply of harsh wool. These, it will be observed, are the chief characteristics of the split-leaf supposed sport, which I accordingly regard as an interesting case of what is usually called 'reversion' to a prepotent ancestor, *G. Schottii* or some of the other cottons of the series to which that belongs. It is a recessive manifestation which without the aid of further hybridisation might be expected to be fixed (see p. 207).

Recessive manifestation.

Layton's Improved.

V. Peterkin Series.—(12) 'Layton's Improved,' from R. D. Layton, of St. Matthews, S.C. This is a plant with broad 5–7-lobed leaves, almost glabrous, and the flowers not much larger than the bracteoles, turning purple with age, bractlets not present; seeds large, linear oblong, densely coated with a white woolly fuzz and fair quality of floss. A hybrid close to *G. mexicanum*.

Toale.

VI. Prolific Medium Boll Series.—(13) 'Toale,' from P. P. Toale, Aiken & Co., S.C. This plant might be spoken of as strongly of the type of Mexican cotton, having very broad fairly deeply 3–5-lobed smooth glabrescent leaves with small pale-coloured flowers only slightly tinged with purple—hybrid of *G. mexicanum*.

Shine.

(14) 'Shine,' from J. A. Shine, Faison, N.C. A plant with the general appearance of some of the Mexican cottons. Leaves medium-sized 3–5-lobed, lobes ogee-shaped acuminate, almost glabrous; flowers small, turning purple-pink; bractlets not present and glands very obscure; seed black, nearly naked, and floss fairly easily separable, but woolly and scanty—hybrid of *G. mexicanum* with a possible strain of *G. purpurascens*.

Lewis Prize.

(15) 'Lewis Prize,' from W. B. F. Lewis, Lewiston, La. This somewhat interesting plant has very broad compact leaves 5–7-lobed, the lobes short and often again irregularly toothed; bractlets not present, and glands not very conspicuous; seed fairly large, rounded below, pointed above, clothed in grey-white fuzz and liberal coating of woolly floss. It is a hybrid strongly *G. mexicanum*.

Long Staple Uplands.

VII. Long Staple Upland Series.—Of the plants placed in this position Mr. Dewey observes 'The Upland long staple cottons yield good crops of a long staple in regions not suitable to the culture of the Sea Island cotton. The lint is a few milimetres shorter than Sea Island, ranging from 34 to 40 mm., while the Sea Island ranges

from 40 to 45 mm. The Upland long staples are grown along the Red River in Arkansas and Texas, and along the Mississippi in Mississippi and Louisiana. Varietal differences in the long staple cottons lie in the size of the boll, the length and strength of lint, and in productiveness.' (Cf. with remarks under *G. hirsutum*, p. 194 and *var. maritima* in Egypt, p. 292.)

(16) 'Allen,' from J. B. Allen, Port Gibson, Miss. This plant has medium-sized leaves, the majority being 3-lobed, some even entire or only angled, glabrescent, smooth, the young parts hairy; glands three; inflorescence solitary axillary and extra axillary, forming extended flowering shoots; flowers medium sized, a little exceeding the bracteoles, and early tinged with purple; petals free almost to the base, oblique thinner margin fringed by strong hairs, often coated with pollen; bractlets not present, external glands obscure, internal ones fairly distinct; calyx wide, loose, shorter than is customary, but teeth very large and obtuse; seeds medium sized, irregularly formed, fuzz imperfect but ashy white; wool very long and silky. This seems a hybrid mainly of *G. hirsutum*, though the leaves are certainly not as hairy as is customary with hybrids of that species. Allen.

(17) 'Peeler' from Texas. In this plant all the young parts are fairly pilose; leaves are smaller than is customary with most Uplands and 3- or 5-lobed, the lobes short broad ogee-shaped, acuminate with folds thrown up at the sinuses; flowers large, pale with the very faintest tinge of purple; calyx loose, the teeth with wide open curved sinuses between, and many-veined; peduncles twisted, external and internal glands small, naked; bracteoles oblong, the three central teeth much the longest; seeds short, rounded with sparse white fuzz and fair amount of long silky white wool. This is clearly a *G. hirsutum* hybrid. Peeler.

(18) 'Simms.' This form would seem to produce flowering lateral shoots to a more marked extent than is customary, the flowers being often extra-axillary and showing a tendency to be clustered. Young leaves and petioles sparsely woolly; leaves broad, 3–5-lobed, lobes almost triangular, acuminate, smooth, glabrous, except on the veins, and only one vein bearing a minute gland below; flowers medium-sized, rapidly turning purple; calyx teeth large, oblong, acute sinuses between, narrow; bracteoles large, the central tooth much prolonged and nearly reaching the length of the corolla; external and internal glands small, naked; seeds large, oblong, densely coated with rust-coloured fuzz and fairly long soft pure white wool. This would appear to be a hybrid of *G. hirsutum* × *mexicanum*. Simms.

Sunflower. (19) 'Sunflower' from Max Shaefer, Yazoo City, Miss. I have ventured to reproduce the specimen of this plant photographically **(Plate No. 42)**, sent by Mr. Lyster H. Dewey for my inspection. I made, however, that selection more on the excellence of the botanical specimen than from any idea of its superiority as a stock. The plant is very hairy, all the younger parts being clothed with long spreading white hairs; leaves 3–5-lobed, the lobes ovate, oblong acuminate, and the sinuses thrown up between, gland below on middle vein distinct, circular, one or more of the other veins often having smaller elongated glands; inflorescence, short flowering shoots with the flowers mostly extra-axillary; flowers small, rapidly turning purple, not much longer than the bracteoles; calyx wide, loose, teeth triangular; bracteoles ovate-rotund, external and internal glands distinct pits, but not protected by bractlets; seeds large, irregular, matted with greyish white fuzz, and large supply of remarkably long soft silky floss. This seems a form of *G. hirsutum*, but has been once or twice doubtless hybridised, possibly with *G. mexicanum* and again with *G. barbadense*.

VIII. Big Boll Series.—Mr. Dewey (*l.c.*) says 'The Big Boll cottons are grown in all the cotton-growing States. They are somewhat late in maturing, and are therefore less popular along the northern border of the cotton-growing region where the seasons are shorter. As a rule, they do not yield a high percentage of lint. The size of the boll varies from 6 to 10 grams in weight.'

Todd. (20) 'Todd' from P. W. Todd, Grantville, Ga. This is a broad-leaved plant, only partially hairy, which comes perhaps nearer to *G. mexicanum* than to any other botanical form. Leaves broad, smooth, hairy on the veins only, lobes 3–5, broad, triangular, acuminate; flowers large, rapidly turning purple; peduncles short, furrowed; calyx relatively small, wide, teeth short ($\frac{1}{3}$ length of tube), triangular; bracteoles very large, ovate-rotund, the central 3 to 5 teeth much elongated, glands both external and internal distinct, large and naked; seeds very large, linear oblong, obtuse at both ends, densely coated with white massive fuzz and with a fair amount of medium length of soft white wool. It is a *G. mexicanum* × *hirsutum* hybrid.

Russell. (21) 'Russell' from J. T. Russell, Alexander City. In foliage this is very much like the last-mentioned form: the leaves are mostly 3-lobed, with a pair of angles or minute teeth occasionally making it 5-lobed; flowers medium sized, early turning purple; calyx wide open cup, with five acute undulations rather than teeth; peduncle

No. 42. GOSSYPIUM MEXICANUM, *TOD.*

'Sunflower': seems a hybrid stock between *G. hirsutum* and *G. mexicanum*, having perhaps a stronger strain of the former than of the latter.

about 1 to 1½ inches long, with external and internal glands distinct, but naked (no bractlets); bracteoles very large, ovate oblong, the three central teeth very long and prolonged together; seeds large, oblong, obtuse, coated with green (turning grey) fuzz and fair amount of woolly white floss. It is a hybrid of *G. hirsutum* × *mexicanum*.

Berry. (22) 'Berry Big Boll' from J. L. Berry, Hampton, Ga. A sub-glabrous plant with broad fairly deeply 3–5-lobed leaves, the lobes oblong acuminate, thrown up in folds; flowers extra-axillary, early turning purple; calyx loose, open teeth, short with wide gaping sinuses between; bracteoles very large, the three central teeth often exceeding the petals; external and internal glands distinct but naked; seeds large, oblong, coated with dense greenish grey fuzz, fair amount of longish, soft, woolly floss.

This is obviously a hybrid closer to *G. mexicanum* than to *G. hirsutum*.

Culpepper. (23) 'Culpepper' from J. E. Culpepper, Luthersville, Ga. In foliage this is much like the rest, but the flowers seem to be borne on lateral flowering shoots, and the seeds are smaller and beaked, the fuzz rusty white and the wool less abundant, though of fair quality and length. It is a hybrid of *G. mexicanum* × *hirsutum*.

Cummings. (24) 'Cummings,' from Bartow Cummings Strand, Chambers Co. Ala. This is still another broad-leaved semi-glabrous plant; leaves mostly five-lobed, the lobes large, broad, and thrown up in great folds between; pods elongated; seeds large, coarsely formed, beaked, with grey rusty fuzz and fair amount of woolly white floss. It is a hybrid of *G. mexicanum*.

Storm Proof. IX. Big Boll Storm Proof Series.—Mr. Dewey (*l. c.*) observes of this series 'The Big Boll Storm Proof cottons are especially adapted to the conditions in Texas, where they originated. The seed cotton is held in the open boll, which hangs downwards, protecting it from rain and wind. The bracts of the involucre are especially large. In many of the other Big Boll varieties the seed cotton does not cling to the boll and is easily blown out.'

Triumph. (25) 'Triumph' from A. D. Mebane, Lockhart, Texas. This is said to be specially adapted to Texas, where it, as also the other Big Boll Storm Proof forms, originated. Leaves very large, five-lobed, the lobes triangular acuminate, petioles very long, glands three below; bracteoles very large, coarse; wool held firmly together in the open boll; seeds large, coarse, with dense grey white fuzz and

short woolly floss which adheres firmly. It is a hybrid of *G. mexicanum* × *hirsutum*.

Gibson. (26) 'Gibson' a form raised by Mr. Gibson, Roddy Van Zant Co., Texas. This is much like the last mentioned in foliage, but the flowers seem much larger, and turn early to purple, the floral glands conspicuous, and the seeds with copious grey-white fuzz but fairly long and almost silky floss.

Myers. (27) 'Myers.' This was obtained from S. B. Maxey, Myers, Texas—the description of the foliage of (25) above would apply to this plant also, but the flowers are here considerably smaller, the petals hardly exceeding the tips of the teeth of the bracteoles; petals early tinged purple; calyx large, teeth prominent, internal glands conspicuous; seeds very large, coarse, obtuse, and wool fairly copious and woolly.

Mention has been made of the fact that Professor Duggar had proposed a classification of the Upland cottons. As this slightly amplifies that just given it may be here briefly reviewed. He has established the following seven groups, some of them corresponding with the groups already mentioned, viz. :—

Dickson. 1. *Cluster Cottons* of the Dickson type, which includes Welborn, Jackson's Limbless, &c. They are early-maturing cottons with the bolls, as the name implies, produced in clusters, and the seeds have a thick fuzzy coat, and the percentage of lint 32 to 34.

Peerless. 2. *Semi-cluster Cottons* of the Peerless type, which includes many well-known cottons such as Boyd, Cummings, Drake, Morris, Hawkins Prolific and Jumbo, Herndon, Tyler, &c. They are medium-maturity cottons, with the bolls more or less clustered, fuzz well formed, and percentage of lint 29 to 35.

Peterkin. 3. *Rio Grande* of the Peterkin type, such as Peterkin's Limb Cluster, Excelsior, Texas Wool and Oak, Wise, &c. Well-branched plants with small bolls, seeds naked, except a tuft of fuzz at the beak. Medium maturity with percentage of lint 35. It may be here added that the Layton's Improved, described above as a form of Peterkin, could not fall into this classification since the seeds possess a fuzz.

King. 4. *Short Limb* of the King type. Plants well branched, limb short, bolls small, seeds small, densely coated with fuzz. Early maturity plants, with a lint percentage of 32 to 34. In addition to King's Improved this includes Lowry.

Duncan. 5. *Big Boll* of Duncan type. This is a large series which, in addition to Duncan, includes Banks, Christopher, Truitt, Thrush, Stickland, Coppedge, Culpepper, Grayson, Russell, Lee, Scroggins, &c., &c. They are heavy and strong late-maturity plants, with the lower branches spreading, the upper short, bolls very large, seeds large, covered with thick fuzz, whitish in colour, and percentage of lint 29 to 34.

Petit Gulf. 6. *Long Limb Upland* of the Petit Gulf type. This includes Gunn, Cheise, Ellis, &c. They are very large plants of late maturity that possess

long and straggling branches. The boll is medium-sized, the seed covered with fuzz of various shades, and the percentage of lint 30 to 32.

7. *Long Staple Uplands* of the Allen type. These are large, open, late-maturity plants that require a good and moist soil. Bolls medium in size, but long, slender; seeds medium to large, covered with whitish lint of fuzz and long staple, percentage of lint 25 to 29. The plants of this assemblage are industrially, perhaps, the best. The examples are Allen's Improved, Allen's Hybrid, Mathew's, Cook, Doughty, Griffin, Cobweb, Moon, &c. Allen.

So extensive is the literature of the Uplands and other cottons of the United States that it would be impossible to mention in this work a tithe even by name. A goodly number have already been placed under contribution, and the following may also be consulted with advantage:—*Spix and Martius,* '*Travels in Brazil,*' I., 1817–1820, *pp.* 189, 191, II., *p.* 15; *Baines,* '*Hist. Cotton Manuf. Great Britain,*' 1836; *Christy,* '*Cotton is King,*' 1856; *Donnell,* '*Hist. Cotton in New York,*' 1872; *Mell,*' *Climatology of Cotton Pl.,*' 1893; *Sheppers,* '*Cotton Facts,*' 1893; *Mortimer,* '*Cotton from Field to Factory,*' 1894; *Watkins,* '*Production of Cotton for* 100 *Years,*' 1895; *True,* '*The Cotton Plant,*' 1896; *Dabney,* '*The Cotton Plant,*' 1896; *Dodge,* '*Useful Fiber Plants of World,*' 1897; *Brooke's* '*Cotton,*' 1898; *Burkett and Poe,* '*Cotton,*' 1906. *Many of the above occur in the publications of the Department of Agriculture in the United States, which literally teem with reports and papers on every aspect of the cotton production and trade.* References.

Upland Cottons in the West Indies.– Sir. D. Morris gives much useful and practical information in the little pamphlet ('The A. B. C. of Cotton Planting' No. 31 of 1904) issued by his department. In the 'West Indian Bulletin' vol. VI., 1905, J. R. Bovell furnishes the results of his experiments in Barbados and the Hon. Dr. F. Watts supplies a similar statement regarding the Leeward Islands. In all these publications and many others the cultivation of the Uplands receives due consideration, but it may be confidently affirmed that the interests of the West Indies are more closely concerned with Sea Island cotton, the success attained recently with that staple being most encouraging. The opinion seems accepted that where Sea Island can be profitably grown no other cotton need be considered. West Indies.

Upland Cottons in Russia.—Mr. John Martin Crawford ('The Indust. of Russia,' vol. III., 1893, pp. 143–9) gives a most instructive account of the cotton cultivation in Asiatic Russia. There would appear to be three distinct plants (or groups of plants) grown:—(*a*) the Asiatic cotton *G. herbaceum* (as he calls it), the cotton which he says 'began to develop itself gradually on the borders of the Oxus (Amou Daria and Seikhoun (Syr-Daria) coming to the north from the south of Asia.' This is apparently the cotton of Turkestan generally, and the species to which the Russians Russia.

resorted to to meet their necessities during the cotton famine of 1860 and subsequent years. (*b*) In Transcaucasia there is a second cotton (*G. Nanking*, no doubt) which has been grown from the most ancient times, and the greater part of the production 'falls to the Erivan government, which supplies more than nine-tenths of the cotton produced in the country. Furthermore, small patches of cotton are met with in the governments of Elisavetpol, Baku, Kutais and even Tiflis. The total production in Transcaucasia is about 600,000 pouds, more than half of which is Upland, the rest being from the local plant, and Jumel, which is cultivated in small quantities only in the Kutais government.' (*c*) The third cotton of this region is the Upland, of which mention has just been made. 'When the Russians took full possession of Turkestan, great attention was paid to the development of cotton-growing, as it was of great importance not only to that province itself but also to Russia, which had to buy cotton abroad, in the United States and in Egypt. Just at that time came the idea of introducing into Turkestan the American cotton plant, which was of superior quality to the local varieties. During ten years all attempts to cultivate American cotton in Turkestan were unsuccessful for many reasons, and especially from the desire to grow the so-called Sea Island cotton, *G. barbadense*, which was unable to weather the dry climate of Turkestan. Only in 1880 was it learned that the Upland cotton, *G. hirsutum*, could be successfully grown there, and immediately energetic measures were taken for its cultivation. In Tashkend a cotton plantation was established; manuals for the culture of the American Upland cotton were published in Russian and in the local languages, and seed was distributed free of cost to those who desired it, and moreover the sale of cotton fibre from American seed was guaranteed.'

'The construction of the Transcaspian Railroad had an important bearing also on the increase of cotton-growing in Turkestan.' 'In 1884 not more than 300 dessiatines were sown . . . and in 1892 the area had been increased to 100,000 dessiatines, of which three-quarters were Upland and one quarter local seed. The yield is now estimated at 2 million pouds, the greatest quantity coming from Fergan territory and the expansion of cotton cultivation in Turkestan is limited only by the amount of land sufficiently irrigated to be suitable for cotton. But with a more economical utilisation of the waters of the Syr-Darya and the construction of new irrigation systems, the cultivation in Turkestan may be greatly increased.' The

following are the forms of Upland cotton most generally grown:—New Orleans, Ozier Silk, Peterkin, Texas, Dickson and Duncan's Mammoth Prolific.

Bractlets.

Weevil-Resisting Adaptations.—In the Kew Herbarium there is a specimen of *G. vitifolium* **(Plate No. 45, f. 3 a)** which was grown in 1864 at Saharanpur, India, that manifests protecting bractlets surrounding the glands within and alternating with the bracteoles, one (not a pair) to each gland. That contrivance was first fully expounded by Mr. O. F. Cook (*l. c.*) in the report of his explorations and studies in Guatemala. He describes the plant as a low spreading annual bush, known to the people of Guatemala as the *kekchi* cotton. It would seem probable that Rohr was describing a cotton very similar to the *kekchi* when he furnished particulars of what he calls the 'spreading' or 'procumbent cotton of Guiana.' His attention was drawn to that particular plant in 1799, and it was recommended to him as being 'storm proof.' It yielded, he tells us, but one crop a year, namely from November to March. He makes no mention anywhere of the boll-weevil, and accordingly had no occasion to discover weevil-resistent stocks. I much regret not having seen an authentic specimen of the *kekchi* cotton, and am, therefore, only speculating as to its specific position when I follow Cook in placing it under the series of Upland cottons.

Kekchi cotton.

I am fully satisfied, however, that the future is likely to reveal several distinct forms, met with in Central and South America, all at present confused with either *G. vitifolium* or *G. mexicanum*, some at least of which might popularly be called examples of Uplands. Among these obscure plants (? species) no doubt the *kekchi* cotton may find its proper place. Cook says that 'the presence of the weevil-eating *kelep* has enabled the Indians of eastern Guatemala to maintain, since very ancient times, field culture of cotton in the presence of the weevils, with the result that there has been developed a dwarf, annual, short-season variety with numerous features which, in the absence of sufficient numbers of keleps, afford material assistance in protecting the crop against the ravages of the weevil' (*l.c.* p. 7).

The kelep.

I accordingly think that Cook may be mistaken in regarding *kekchi* as a form of *G. hirsutum, Linn.*, though by hybridisation certain of its peculiarities might easily enough have passed into special forms of the modern Upland cottons which, as we know them, are mostly hybrids of *G. hirsutum* × *mexicanum*. It will be seen

that bractlets protecting the glands in Molango Mexican cotton (grown at Washington), have actually been detected by me in a specimen (n. 615), kindly supplied by Mr. L. H. Dewey but in no other example of the extensive series of Uplands which he has been good enough to furnish (see pp. 230 to 240).

Hindi weed.

But it is most significant that the cotton supplied to me from Egypt by Mr. W. Lawrence Balls of the Khedivial Agricultural Society, Cairo, under the name 'Hindi Weed' should prove to be exactly the Molango and to possess the minute bractlets seen in that plant. Moreover the plates furnished by Cook show, as I take them, *G. vitifolium* (Pl. II., ff. 1, 2; Pl. III.; Pl. x., f. 1) rather than *G. hirsutum*. When to all this is added the fairly well ascertained distribution of the two plants named, it becomes evident that the Guatemala weevil-resisting cotton differs materially from *G. hirsutum*, though it might be *G. mexicanum*, and in some respects even *G. peruvianum*. In passing it may be added that I have occasionally seen bractlets in several distinct species, as for example in *G. obtusifolium, var. africana* (**see Plate No. 23 C, f. x**); *G. Sturtii* (**see Plate No. 2, ff. 4, 4 a**) and *G. Palmerii* (**see Plate No. 34, f. 3 a**), species so far as known that have never been visited by the boll-weevil.

Mexican cotton.

But it is certainly curious that an undoubted wild plant in Mexico (*G. Palmerii*) should possess bractlets protecting its internal glands, much as Cook has described the bractlets of the Guatemalan *kekchi* cotton plant since, according to Cook the Mexican cottons are not subject to the weevil.

The following passages from Cook's account of weevil-resisting adaptations may help to make his results and conclusions clear:—

Guatemalan cotton.

'The Guatemalan cotton protected by the *keleps* is a genuine Upland variety, very early and productive, with a fibre of good length and texture, as already stated.' 'It belongs to *G. hirsutum*, the Upland species or series of varieties, in the sense that it is not a Sea Island, Egyptian, or Kidney cotton, but it is distinctly more different from any of the Upland varieties now cultivated in the United States, than these are from each other' (*l.c.* p. 8)

'The whole Upland type of cotton appears to have been originally a native of the Central American region.' 'Varieties which reached the United States from Mexico and the West Indies may, however, have had little or no contact with the weevil for many centuries, while in Central America the struggle for existence has remained severe and continuous down to the present day. It is now known

that in the plateau region of Mexico the long dry season effectually excludes the weevil, so that varieties of cotton from the Mexican highlands, instead of being weevil-proof, as sometimes represented, may have no immunity whatever when brought into the much more moist climate of the cotton belt of the United States' (*l.c.* p. 10). Mexican cottons.

'It is not improbable that the Upland varieties previously known in the United States came originally from the more or less arid regions of Mexico, where absence or very small development of the basal branches keeps the ground from being constantly shaded and gives better chances for the weevils to be killed by the drying out of the fallen squares.'

'Our Upland cottons are undoubtedly of American origin, but the region from which they came has not been ascertained. Some of the Texas varieties are said to have been brought from Mexico. Coronado's Journal of the earliest Spanish exploration in Arizona and New Mexico contains many references to the cultivation of cotton by the Indians. There can be little doubt that the agricultural Indians of the Gulf region also cultivated cotton, though no documentary evidence of the fact seems to have come to light as yet.'

'It is highly probable that the original home of the cotton plant, and of the boll-weevil as well, was in a somewhat arid region, since it is only under such conditions that the weevil would be effectually prevented from increasing to the fatal degree of destroying its host plant, and thus cutting off its only means of subsistence. On the other hand, it was only in a humid country like Eastern Guatemala that many of the weevil-resisting adaptations would be likely to develop if, as now appears, it has required the selective influence of the boll-weevil itself to bring them to their present advanced development.' Boll weevil.

'The adaptive character of this habit of shedding the parasitized squares seems to be confirmed by the fact that it depends upon the existence of a special layer of soft cells which readily break down when the bud is injured. Many plants have such cells as a means of shedding their fruits, but they seem not to be prevalent among the relatives of the cotton. The cotton itself does not drop the ripe bolls, and even the empty shell often remains long after the seeds are gone. The drier the climate the more effective is the prompt shedding of injured squares' (*l.c.* pp. 44–5).

Mr. Cook shows the plant (Plate II., ff. 1 & 2) with leaves ovate entire below, 3-lobed near the middle and 5-lobed near the top;

Rabinal cotton.

lobes oblong acute or acuminate, sinus narrow and thrown up in folds—characters that would suggest *G. vitifolium*. In Plate III., he exhibits the bracteoles almost free, only slightly cordate, teeth with long awl-shaped tails, alternating are three glands each protected by a pair of bractlets; calyx 5-toothed and tailed. Plate IV. represents the bracteoles of Rabinal cotton (f. 1) much united (a protective feature) and of Egyptian quite open (f. 2).

In a footnote (p. 43) Cook says that Pachon cotton from western Guatemala grown in an experimental plot at Lanham, Md., had a large calyx completely covering the bud. It may be suggested that the plant in question may have been *G. microcarpum*, the only species known to me with the calyx so large as to completely enclose the bud. **(See Plate No. 36, f. 1.)** The Rabinal cotton seems worthy of special inquiry, since the much united bracteoles might be suggestive of an influence derived from the cottons of Section II. (p. 77) the majority of which are Asiatic species. A very striking plant of this nature is a specimen in De Candolle's Herbarium grown by L. Hahn in Martinique in 1870. It might be described as a hybrid of *G. vitifolium* with fuzzy seeds and much united bracteoles.

SECTION IV.—Naked-seeded Cottons with the Bracteoles free or nearly so and Glands conspicuous.

BRACTEOLES *only slightly united below or free; possessed of large conspicuous external glands within the auricles and often also between the bracteoles and the calyx;* SEEDS *naked or nearly so and floss easily removable;* LEAVES *often very large, mostly glabrous.*

There are both Old and New World forms in this section, but only one, so far as at present known, has been met with in what appears a truly wild condition, and that species might be spoken of as Polynesian. Two others have been occasionally seen either as wild plants or as escapes from cultivation, namely *G. brasiliense* and *G. vitifolium*.

ANALYTICAL KEY TO THE SPECIES.

* *Twigs strongly angled, glabrous and purple coloured; leaves ovate, faintly cordate, entire or three-lobed across the apex; flowers small, only slightly exceeding the bracteoles; petals yellow tinged with purple.*

† Leaf-stalks when young ciliate, lobes of the leaves directed upwards; calyx cup-shaped, teeth 3-veined, acuminate or

awl-shaped; seeds pale brown, quite naked, rounded or not angled **37. G. taitense** . . . . (p. 248).

†2 Leaf-stalks warted, rarely ciliate, lobes of the leaves arching outwards; calyx teeth 3-veined, but at most acute, never tailed; seeds rounded, beaked, and often with very slight fuzzy tuft on the apex

38. G. purpurascens. . . . (p. 250).

** *Twigs faintly angled on the young growing parts and pedicels, green or brown coloured; leaves ovate-oblong, more or less cordate, entire or 3–5 deeply palmately lobed; flowers large, nearly twice the length of bracteoles or more, petals pure yellow but with conspicuous purple claws.*

† Leaves pilose-tomentose below, lobes somewhat irregular but more or less ascending, broad, usually only 3, and the central one often much longer than the laterals; flowers frequently three times the length of bracteoles, and the fruit 3-, 4-, often 5-celled; seeds free, brown, glabrous

39. G. vitifolium. . . . . (p. 255).

†2 Leaves very nearly glabrous, half or more segmented into 3–5 spreading oblong acuminate lobes; flowers hardly more than twice the bracteoles, and fruit 3-, 4-, mostly 3-valved; seeds free, brown, almost glabrous

40. G. barbadense. . . . (p. 265).

†3 Leaves almost quite glabrous, and in herbarium specimens usually drying into a brown colour, deeply cordate, very broad and large, cut into five palmately spreading acuminate lobes, the central one the longest, and often from 4 to 8 inches in length; flowers very large, and bracteoles sometimes maculated on the inner surface; fruit 3-celled, and seeds almost quite naked, striated, and united into a kidney mass **41. G. brasiliense.** . . . . (p. 295).

Assortment by date.

If the two assemblages of what have been called fuzzy-seeded cottons manifest many perplexing problems as to their origin and the limitations that have to be placed on the species, varieties and races known to exist, these difficulties are increased tenfold when the naked-seeded cottons, that it is here contemplated to review collectively, are taken into consideration. One point, however, stands out fairly vividly, namely, that when a record of our

knowledge is assorted in sequence of date one of the most satisfactory hints as to the origin of the cultivated forms is obtained, and a useful key afforded regarding possible future developments.

Wild species.

Embraced under the naked-seeded section there may be said to be three or four well marked forms (species) each with its associated group of cultivated agricultural and commercial grades. Only one has, however, been found under conditions such as to justify belief that it is a well marked wild species, viz. *G. taitense, Parl.*

African form.

The expression 'naked-seeded,' though convenient and useful, must never, however, be accepted rigidly. Nearly all the members of that assemblage possess a slight tuft of fuzz around the apex (beak) of the seed, some even have a tuft at both extremities. There is perhaps only one absolutely naked-seeded cotton, so far as our present knowledge goes, and that is an African wild species, viz. *G. Kirkii*, which, while allied to the group of cottons under consideration (more especially to *G. brasiliense*), possesses sufficient independent characteristics to warrant its being placed in a section by itself—the prototype possibly of others to be discovered or even evolved in the future. The exact bearing of *G. Kirkii* (a species never recorded as met with under cultivation, and which possesses what may be called absolutely naked seeds) on the problem of existing and future commercial cottons would seem an issue of superlative importance.

Its influence.

Readily separable wool.

The ease with which the silky wool of the naked-seeded cottons separates from the seed is an even more certain characteristic than the absence of fuzz (p. 43). It would seem, moreover, that under hybridisation the peculiarity of a naked seed is instantly destroyed, and that the appearance of completely fuzzy seeds in the progeny of a so-called 'naked-seeded' stock, may denote a recessive characteristic from a fuzzy-seeded ancestor. Be that as it may, there remains the curiously interesting fact that from three great centres there would appear to have emanated the naked-seeded-readily-separable-wool condition, centres that approximately correspond with the indigenous habitats of actual or presumed wild forms. In the Polynesian Islands, 1, *G. taitense* is met with both wild and cultivated; 2, on the east side of the Continent of Africa *G. Kirkii* occurs; and 3, in South America *G. brasiliense* and possibly also *G. vitifolium* originated. But let it be added these habitats are approximately situated between 15° N. and 20° S. latitude. Both north and south of the equator is placed the region of *G. brasiliense*

Centres of naked-seeded cottons.

and of *G. vitifolium*, and south that of *G. taitense* and *G. Kirkii*. But while *G. taitense* has been recorded as met with (possibly only acclimatised *G. purpurascens*) in Madagascar and the Mascarene Islands (in addition to the indigenous habitat of Polynesia), *G. Kirkii* has never, so far, been recorded as discovered outside the portion of East Africa already mentioned. The value of *G. taitense* and its immediate cultivated state (*G. purpurascens*) on the production of some of the more highly prized staples of modern commerce, has never been systematically investigated, but it would seem probable it has had much to say to several forms, such as *G. mexicanum*, if not also *G. vitifolium*, the other element in some of the forms being *G. punctatum, var. jamaica*. On the other hand the influence of *G. brasiliense* on *G. purpurascens* hybrids in producing *G. barbadense, var. maritima* seems fairly certain (see pages 254, 263, 279–81, 285–7, &c.). Every historic fact that has even the most distant bearing on the naked-seeded cottons would seem to point to the belief that, prior to the closing decades of the seventeenth century, naked-seeded cottons were little, if at all, known in the chief areas of cotton cultivation, as for example in India, Egypt, and America, and when we first make acquaintance with them they are found in Polynesia.

Hybrids.

It is also worthy of passing note that the condition of naked seed appears closely associated with naked foliage—the prevailing feature of the leaves of the majority of the species and races of this series being glabrous or nearly so. It was this circumstance doubtless that suggested the name *G. glabrum*, given by Lamarck in 1786, to a plant which (excluding the synonyms incorrectly associated with it) can be nothing more than a cultivated state of *G. taitense*. And it may be here pointed out that Lamarck observed that he was unable to decide whether to put his new plant under *G. barbadense, Linn.*, a species of which he (like most other botanists of that period) admitted having had but very imperfect knowledge. He, however, informs us that *G. glabrum* had only lately been cultivated in the Royal Gardens of Paris, and that the seed came from the Antilles. For very nearly a century after Lamarck's time, *G. purpurascens* was viewed as only a state of *G. barbadense*, if it was not treated as synonymous with it. The French colonists carried *G. purpurascens* throughout the world, and to that circumstance is due its having come to bear the name of Bourbon Cotton. The British colonists, on the other hand, were more especially associated with the fuzzy or green-seeded plant, *G. hirsutum*.

Glabrous foliage.

From the Antilles.

Bourbon cotton.

Novelty of naked seed.

The novelty of the naked seed thus appears synchronous with the publication by botanical authors of the species that are now regarded as alone possessing that peculiarity. It was accordingly customary for the early writers to speak of the green and of the black seeded cottons. And this subject seems to have continued to arouse attention for some considerable time, or until Dr. Buchanan-Hamilton seriously proposed a botanical classification of the cottons of the world into (*a*) *album*, white or fuzzy-seeded, and (*b*) *nigrum*, black or naked-seeded cottons.

To the breeder of new stocks the importance of the naked-seeded forms with readily separable silky flosses cannot be over-stated.

37. G. TAITENSE, *Parl.*, *Sp. dei Cot.* (1866) *p.* 39 *t.* VI., *f.* A; *G. RELIGIOSUM, Solander in Seem., Fl. Vit.* 1865, *p.* 22; *also Seem., Journ. Bot.* (1866), *p.* 268–70; *G. TAITENSE, Tod., Relaz. Cult. dei Cot.* p. 195; *G. RELIGIOSUM, Hilleb., Fl. Hawaiian Isl.* 1888, *p.* 51; *G. TAITENSE, Vesque, Trait. de Bot. Agri. et Indust.*, 476; *Aliotta, Riv. Crit. Gen. Goss.* 1903, *p.* 95.

Wild cotton of Polynesia.

Description.

This species may be recognised by the following characters, when taken collectively:—An erect, straggling bush, when mature, glabrescent and purplish-green, but with the younger parts occasionally more or less ciliated, through the presence of long, weak hairs; leaves, ovate-oblong to sub-rotund, scarcely cordate, acute or acuminate, entire, irregularly angled or having three ascending lobes on the upper third, uniglandular; bracteoles usually quite free to the base, nearly as long as the corolla, ovate oblong, acute, deeply auricled, also laciniated into long, narrow fimbriated teeth; calyx cup-shaped, ending in 5 ovate oblong, acuminate or even awl-shaped and usually fimbriated teeth, veins three to each sepal, glands large, alternating with the bracteoles; seeds rotund, not angled nor pointed, and having a very imperfect fuzz (or entirely naked), and a rusty floss which cannot be handled without separating from the seeds. **(See Plate No. 43.)**

In its mature state this plant often looks quite glabrous, smooth, and polished; *twigs* angled, purplish-green, very minutely gland-warted, woody, with short much branched terminal shoots. *Leaves* minutely dotted, often almost reniform, truncate below (but only very faintly cordate), entire or irregularly angled and lobed, or with three, very rarely five, deltoid acute lobes, the two laterals pointing upwards (only very slightly arching outwards) and the central lobe not much longer than the laterals, the leaf being

M. Smith delt, J. N. Fitch lith. West, Newman imp.

No. 43. GOSSYPIUM TAITENSE, *PARL.*

1, Flowering shoot, angled and often ciliate; 2, portion of leaf showing the gland; 3, flowering bud with subtending free bracteole, calyx with long teeth and prominent glands; 4, seed rounded, not pointed, but with a very imperfect fuzz.

often broader than long, owing to the expansion of the ear-like lower portions of the blade, 1 to 2½ inches broad by 1 to 2 inches long; *petioles* longer than the blades, slender, angled, warted, and with a few long hairs near the apex; veins 5–7, the central one only with an obscure gland, near the base; *stipules* ovate oblong to linear-lanceolate, pilose, very caducous. *Inflorescence* short lateral aborted branches, terminated by one or two flowers, and bearing one or two ovate entire or angled leaves; *bracteoles* with 7 to 9 fimbriated teeth; *peduncles* almost square, furrowed, and ending in a thickened cavernous gland within the auricles of the bracteoles. *Flowers* small, pale yellow with a purplish tinge; corolla very woolly on the outer margins; *calyx* campanulate, relatively very large. *Fruit* small, sub-rotund to ovate oblong, acuminate, 3- to 4-celled; seeds and floss already fully described. Pollen-grains see **Plate No. 53, f. 19.**

Habitat.—A wild or, at all events, non-cultivated species found in the Mascarene, Malayan, and Polynesian Islands—more especially the Sandwich Islands, where Captain Cook found it wild. Polynesia.

Citation of Specimens.—In the Herbarium of the Royal Botanic Gardens, Kew, there are only a few sheets of this imperfectly known wild plant, such as the samples collected by the Rev. R. Baron in Madagascar, n. 881; those discovered by Professor J. B. Balfour, during the Transit of Venus Expedition at the Island of Rodriguez; a sample from Maibung Sulu Islands, Philippines, collected by Vidal (n. 2,185, wild) (which seems to belong to this species though the calyx-teeth are short); the specimens procured from New Caledonia by Deplanche (nn. 130 and 417) and by Paucher (wrongly named *G. religiosum*). Specimens.

In the British Museum Herbarium there are many interesting specimens, such as those made by Christopher Smith (Voyage of the 'Providence') in Otaheite (Tahiti) in 1791—perhaps the oldest sample extant; the specimens collected by J. R. and G. Forester in Tahiti.

In M. de Candolle's Herbarium, Geneva, there is a specimen collected by Morrenhout in Tahiti.

Nomenclature.—The species is thus essentially an insular plant, and may be said to be confined to the islands of the Pacific Ocean. It has been collected there between 15° N. (Philippines) and 22° S. (New Caledonia). In its Indian Ocean habitat, namely, 12° to 22° S. (Madagascar, &c.), it is possibly only an acclimatised, not a truly indigenous species. The specimens recognised in the above citation as belonging to this form must, however, be those of an indigenous or at all events a non-cultivated plant, since the wool afforded would be quite useless. It seems the correct view therefore to regard its cultivated states as the forms described under *G. purpurascens*—the Bourbon Cottons. An insular plant.

Parlatore's description of *G. taitense* is better than his drawing, where the leaves are shown as distinctly cordate, too deeply palmately-

sected, and most of them 5-lobed, whereas in the plant seen by me the majority are only 3-lobed. The calyx tube is figured and described as much shorter, and the teeth relatively very much more suddenly and pronouncedly tailed, than would seem to be the case. Neither in the Herbarium of Florence, nor in that of Naples, was I able to discover a type-sheet, that is to say, an example of this species named in Parlatore's own handwriting. Still, the specimens above indicated constitute a good species, and I believe they are the plant intended to be described by Parlatore.

38. G. PURPURASCENS, *Poir.*, *Lamk., Encycl. Method. Bot. Supp.* (*pub.* 1811), II., 369 *also in Dict. des Scien. Nat.* XI., 1818 *p.* 40; *Brown Bearded Cotton, Edwards, Hist. Br. Col. of West Indies*, 1793, II., *pp.* 270–1; *Coton Indien also Coton Siam, in Rohr, Obs. sur. la Cult. du Coton* 1807, *pp.* 37–43; G. GLABRUM, *Lamk., Encycl.* II., *p.* 135 (*in part*); G. RACEMOSUM, *Poir., Supp. Lamk., Encycl.* II., (*non Rohr*) 370; G. PURPURASCENS *and* G. RACEMOSUM, *DC., Prod.* 1824, I., 457; G. BARBADENSE, *Roxb., Fl. Ind.* III., 187; G. PURPURASCENS, *Macf., Fl. Jam.* (1837) 73; G. PURPURASCENS, (*Bourbon Cotton*) *Royle, Cotton in India*, 1851, *pp.* 147, 151, *t.* III., *f.* 2; *Andersson, Om Galápagos-öarnes Veget. in Kongl. Vet. Akadem. Handl.* (1853), *p.* 228; G. BARBADENSE, *Wight, Illust. vol.* I., *p.* 57, *t.* 28 *a*; G. PURPURASCENS, *Todaro, Relaz. Cult. dei Cot.* (1877–78), *p.* 244–7; *also* G. RACEMOSUM, *Tod., l.c. p.* 268–70, *exclude t.* XII., *f.* 35.

The Bourbon and Porto Rico Cottons, sometimes also called Siam Cotton. Through a mistake this has been included by some authors under *G. barbadense*, owing to the seeds being naked in both species.

Description. The readiest eye-marks to distinguish this species are its perennial habit; twigs angled, purplish, sub-glabrous and glaucose; leaves small and for the most part having 3 lobes, the laterals of which point outwards and upwards; glands one on middle vein near the bottom; bracteoles sub-rotund, deeply gashed, and peduncle terminated in 3 glands, within the auricles of the bracteoles; calyx large, loose, truncate or shortly toothed, never tailed; seeds smooth, large and nearly naked, though true wool copious and silky. **(See Plate No. 44.)**

It is a climbing shrub or scrambling small tree (15 to 20 feet) with its long branches purpurascent, prominently negro-papillose, sub-glabrous,

M. Smith delt, J. N. Fitch lith.

West, Newman imp.

No. 44. GOSSYPIUM PURPURASCENS, *POIR.*

1, Flowering shoot showing angled gland-dotted stems; 2, bud with short teeth and slightly united bracteoles; 3, fruit oblong acuminate; 4, seed rounded beak enclosed in a tuft of rufous hairs.

and blistering, though the very tips may be pilose. *Leaves* often stellately pubescent below, especially on the veins, and when young broad-ovate, prominently acuminate and apiculate, deeply cordate, occasionally entire, more frequently regularly 3- or very occasionally 5-lobed, the lateral lobes with their tips arching outwards (not ascending as in *G. taitense*) sinus between the lobes rounded, open flat (not thrown up in folds), 1½ to 4 inches broad by 1½ to 3 inches long; *petiole* straight, rigid, usually longer than the blade, glabrous; veins 5–7 with an obscure gland on the middle vein, a vein which is seen below as if it ran straight through the others into the petiole without uniting with them; *stipules* ovate oblique linear, prominent and persistent on the annual shoots, especially below the pedicels. *Inflorescence* leafy lateral rigid shoots, bearing one or more flowers and one or more small-sized ovate entire or lobed leaves; *bracteoles* practically free to the base, glabrous, ovate, sub-rotund, acute, deeply auricled, gashed into 7–9 long linear lanceolate teeth; *pedicels* short angled, ending in thickened cavernous glands. *Flowers* small yellow with a purplish tinge, and often even with deep stains on the claws; *petals* minutely woolly on the outer margin; *calyx* wide campanulate from a distinct tubular base, crenately or dentately toothed, sometimes even acuminate, but not tailed as in *G. taitense*, glabrous, many-veined, glands alternating with the bracteoles, inconspicuous. *Fruit* oblong acuminate, 3–4-celled, circular in transverse section; *seeds* ovate acute or beaked, not angled, with a rusty tuft of fuzz around the beak, otherwise black, smooth, naked; *wool* pure white, soft, silky, easily removable.

Description.

Habitat.—An essentially insular cultivated plant (though often met with as an escape). Recorded between the 20° N. and 20° S. latitude from Hainan to New Caledonia, and westward to the Andaman Islands, South India, Madagascar, East Africa, Upper Egypt, and the West Indies.

Insular regions.

Citation of Specimens.—In the Kew Herbarium there are examples from:—China: Hainan, R. Swinhoe; India: Pabna, Herb Hook. f. and T. T.; the Andaman Islands, Kurz; South India, Rottler's herb. (named *G. religiosum*); Royle's sample named *G. barbadense* and Wight's n. 180, which in Kew Herbarium is this species and in Glasgow is *G. mexicanum*. Polynesia: New Caledonia, E. Caldwell and Diego Garcia, G. C. Bourne, n. 33 (it was found not far from Point Marianne, 'but from its position I should not think that it had been imported'). Africa: Livingstone's South African Expedition, 'Cotton growing uncultivated on the sands near the Kongone mouth of the Zambesi, November 25, 1859'; Nubische Kuste, collected by Dr. G. Schweinfurth, 1867, n. 1,605; Bar-el-Ghazal, collected by H. Broun, n. 77 (a single plant growing in Zareba at the Pongo Station), n. 79 from Badaris, n. 70 from Limbos, and n. 655 Mountaz Cotton from Abdin Sennar, so also Mr. Broun's 'Wild Cotton of the Khor Attar, White Nile,' n. 67 (is doubtless this plant, which, both in India and Africa, is often met with in a semi-wild condition); Kordofan, Steudner, n. 115. Mascarene Islands: Madagascar (Voyage, M. de Boivin, 1847–52, and second sample by W. W. Perry from same locality). West Indies:

Specimens.

Porto Rico by Paul Sintenis, determined by Garcke, n. 547 (with the remark 'Salinus de Cabo-Rojo in sylvis litoralibus'). San Domingo, collected by V. Jacquemont in 1827 (named *G. hirsutum*? Pers. Ex. herb. J. Gay, leaves almost hairy). AMERICA: Brazil, Major Trevor Clarke (confer with remarks under *G. hirsutum*).

In the British Museum Herbarium there is an interesting series which embraces duplicates of some of the examples above mentioned, and in addition the following: CHINA:—herb. Hance, n. 32,295. INDIA: Dacca, coll. by C. B. Clarke, n. 6,770; Coimbatore, n. 15,367; Wall. Cat., n. 1,875, Bhutan (there are two plants on the sheet, the other being ? *G. brasiliense*); lastly a specimen from Tranquebar. POLYNESIA: Tahiti, specimen by Banks and Solander collected during Cook's first voyage, named *G. religiosum* and published as such by Seemann in Fl. Vit.); Tahiti, Barclay, specimen n. 3,275, collected in 1840; Vieillard, n. 130 from New Caledonia. AFRICA: West Coast, Welw., nn. 5,223, 5,226, and 5,235; Zanzibar, Stewart, collected 1862. WEST INDIES: Porto Rico, P. Sintenis, n. 3,717 (named *G. herbaceum*).

In the Edinburgh Herbarium there are examples in addition to some of the above that may be specially mentioned:—INDIA: Buchanan Hamilton, n. 1,550 (which he names *G. nigrum læve*, and observes *Colitur in Camrupæ hortis rarius.* The sample was collected at Sibgunj, East Bengal, on November 21, 1809. Also specimens from Canara, Hohenack. Arzn. u. Handelspfl. n. 449. WEST INDIES: Dominica, n. 578. CENTRAL AFRICA: Schweinfurth, n. 587; and lastly a specimen ex herb. Rdi. C. Alexander, named *G. siamense.*

In the Cambridge University Herbarium there are several samples (ex herb. Lindley) of this plant, more especially two with red-coloured flosses which are spoken of as 'Red Siam Cotton,' or the species from which 'nanking is manufactured.' But it would appear both these were contributed by Wight from Coimbatore in Madras, and one of them is named *G. religiosum.*

In the Calcutta Herbarium there is a fairly extensive series of plants that fall under this species, such as the specimens ex herb. Heyne placed under Wallich Cat. n. 1,875—several of these are marked H. B. C.; ex herb. S. Kurz, a specimen grown at Seebpore and a further sample of the same named *G. acuminatum*; another specimen marked H. B. C. is named *G. religiosum* and has *khaki*-coloured wool; from Assam there is a specimen collected by (?) Dr. McClelland in 1846; from Madras a specimen collected by T. Kistnasawmy Naidoo, 1884; from the Nilghiri hills collected by B. Schmid; a somewhat remarkable plant that looks not unlike a form of *G. mexicanum*, collected by Col. D. Prain at Minikoy in the Laccadive Islands (H.M. I.M. 'Investigator,' 1891); lastly a specimen from (?) Mauritius named *G. religiosum.*

In the Herbarium R.E.P., India many examples such as nn. 1,777 Verawal, growing in a hedge, Baroda, n. 1,888, &c., &c.

In the Economic Herbarium, Bureau of Plant Industry, U.S. Department of Agriculture, Washington, a specimen recorded as 'Wild Cotton growing near the sub-tropical laboratory, Miami.'

M. Casimer de Candolle's Herbarium, Geneva, contains a specimen, n. 210, collected by Zollinger in Java; Welw. Herb. Angola, n. 5,235.

Nomenclature.—The separation of the present species from *G. taitense* is doubtless a matter of considerable uncertainty; all the wild or fully acclimatised forms would be that plant and the cultivated or recently cultivated ones the present species, while the more highly developed forms would merge into *G. mexicanum*. That the Bourbon cottons are cultivated plants, derived from *G. taitense, Parl.*, there would seem no doubt, and it is certainly significant that when met with in Polynesia, they uniformly manifest the distinctive features assigned above to *G. taitense*. The assemblage of cultivated forms bears in its relation to that species an almost exactly parallel position to that which the series known under the name *G. hirsutum* (the New Orleans cottons) bears to *G. punctatum, Sch. et Thon.* (*G. jamaicense, Macf.*). Cultivated states.

I may not be correct in placing *G. racemosum, Poir.*, as a synonym for the present species, but it came from Porto Rico, where examples of the true *G. purpurascens* have been repeatedly collected. It may also be added that from that island have come in addition examples of a plant slightly different from what I take to be the type condition of *G. purpurascens*. It is just possible, therefore, that these may be the *G. racemosum, Poir.* For example, the specimens collected by Sintenis are distinctly peculiar. The leaf-stalks are pale pink and the flowers very small and numerous. It is spoken of as found in the forests along the seashore, from which circumstance it may have been wild. There are good examples of the plant in question both in the British Museum and Kew Herbaria, as well as in M. Casimir de Candolle's great and historic Herbarium at Geneva. The name *racemosum* was given apparently to meet the circumstance not uncommon with wild species of *Gossypium*, namely the persistence of lateral flowering shoots thus simulating a false condition of racemose inflorescence. Todaro was in error when he placed this plant under his subsection *Synspermia* and figured the seeds as naked and *kidneyed*. That mistake was possibly originated through the present plant having incorrectly been called *G. religiosum* by certain writers, and thus confused with the *G. religiosum* of others, which was undoubtedly *G. brasiliense*—the kidney cotton. There is just the probability also that the suggestion made by Poiret that Rohr's Porto Rico cotton was the present species caused the error, for Rohr makes it quite clear that his plant had fuzzy seeds united into a pyramidal column, thus *G. microcarpum, Tod.* The racemose cotton.

Some specimens examined by me cannot be separated from

Purpurascens versus *mexicanum.*

G. mexicanum, though when the seed has a distinct fuzz that circumstance may as a rule be accepted as justifying their removal from *G. purpurascens*. In others the wool is often even rufous or *khaki* coloured, thus marking very possibly a return to the wild condition of *G. taitense*. Poiret (*l.c.*) says that M. Ledru had furnished him with a sample of cotton from Porto Rico which he identified with the plant mentioned in Rohr's 'Observ. on Cotton,' p. 67, as obtained from that island. But Poiret adds that the seeds are often partly or wholly covered with down, so thick that the colour of the seed cannot be readily perceived—a peculiarity suggestive (as just stated) of *G. microcarpum*, more especially as Rohr himself speaks of the seeds in addition as firmly pressed against each other. Edwards ('Jamaica' *l.c.*) calls this the 'shrub cotton,' and alludes to the fact that the staple is much depreciated through the seed being soft and thus readily broken up and hence mixed with the wool. He also alludes to a brown form with a partially fuzzy seed, doubtless a hybrid race, which he calls Nankeen.

Shrub cotton.

Cultivation.—Nearly all the early French explorers refer to a cotton with naked seeds or to cotton of high merit seen by them in the Antilles. So far as I can learn the cottons in question were very largely, one is tempted to say almost exclusively, the present species, and to the French, therefore, is due the early distribution of this plant and to its having come to be designated Bourbon cotton. It would appear to be essentially an insular plant. In a volume of correspondence on the 'Culture and Manufacture of Cotton' (published by the East India Company in 1836, p. 54 *et seq.*) are numerous letters that tell of the experiments made with a view to acclimatise this species in India, the seed having been procured from Mauritius. The endeavour seems then to have been mainly made in Kaira District, Bombay. In 1816 it is said the Honourable Court would learn with regret that a further consignment of seed had been procured before it had been ascertained that the experiment had proved a failure. According to Donnell, Bourbon cotton was introduced into Gujarat in 1814. It would appear to be the 'Indian cotton' of Rohr's account of the cottons grown in Sainte-Croix in 1785–90. (See 'Obs. sur la Cult. du Cot.' pp. 37–9.) Rohr found it in Colombia, near Carthagena, being there cultivated by a highly intelligent Native—hence the name he gave to it of 'Indian cotton,' a name that led to the confusion of its being a cotton of India. Rohr further observes that it bears twice a year a very white and silky floss, not injured by rain, and which separates readily from the seed. It can be planted

Antilles.

India.

South America.

month by month throughout the year, but the plantation put down in November, 1787, did the best. In describing the leaves of this plant Rohr uses the expression that they are convex, a remark perhaps intended to denote the abrupt termination in three short teeth arching outwards and upwards. It is a perennial, and has a remarkable straggling habit. In a further paragraph I return to the use Rohr suggests (see page 334), of this plant as a stock to give in hybridisation the property of a silky readily separable floss. (Cf. with Branner's *quebradinho* cotton, p. 309.)

Polynesia.

Sadebeck ('Kulturgewachse der deutschen Kolonien,' pp. 304–10) gives a detailed account of cotton and cotton cultivation in the German Colonies. It would seem probable that the present species is the plant dealt with for the most part, though Sadebeck urges attention to be given to Sea Island cotton (cf. Isert, 'Reise nach Guinea,' Kopenhagen, 1788). In this connection it may be added that it is somewhat curious that while German writers commend the long staple cottons as most worthy of consideration, Germany should be the most important foreign market for Indian low grade and short staple cotton.

39. **G. VITIFOLIUM, *Lamk.*,** *Encycl. Meth. Bot.* (1786) II., *p.* 135 (*excl. syn. Pluk., Alm. t.* 188, *f.* 2, *added doubtfully by Lamk.*); *Ichcaxihuitl of Ximenes* (*according to Piso, De Med. Bras.* II. 60), 1615; *Ychcaxihuitl of Hernandez, Nov. Pl. Hist.* (1651), *p.* 308, *also ? illustration*; *Xylon arboreum, Merian, Surinaamse Insect.* (1679), *t.* 10 (*leaves a little too deeply lobed*); *Père Labat, Nouv. Voy. aux Isles de l'Amer.* 1724, I., *pt.* 2, *pp.* 125–31; G. *LATIFOLIUM, Rumphius, Herb. Amb.* IV. (1750), *p.* 37, *t.* XIII. (*leaves a little too deeply lobed, also excl. syn.*), (*it is somewhat significant that Roxburgh refrained from making any reference to that plate*); G. *VITIFOLIUM, Cav., Diss., p.* 311, *t.* 166 (*excl. syn. Pluk., and G. glabrum, Lamk.*); *Willd., Linn., Sp. Pl. 4th ed.* (1800), III., *p.* 804 (*excl. syn. Pluk.*); *Guiana, Rohr, Observ. sur la Cult. du Coton*, 1807, *pp.* 7, 31–4; G. *BARBADENSE, Bot. Reg.* (1815), *t.* 84; G. *TRICUSPIDATUM, Tussac, Fl. Ant.* 1818, *vol.* II., *t.* 17 *only*; G. *VITIFOLIUM, Poir., Dict. des Sciences Nat., vol.* XI., *p.* 39 (*excl. syn.*); G. *VITIFOLIUM, in part DC., Prod.* 1824, I., 456; G. *VITIFOLIUM, Saint-Hilaire, Fl. Bras. merid.* 1825, I., *p.* 254 (*excl. syn. Marcg.*); G. *BARBADENSE, Hooker & Arnott, Fl. of Beechey's Voy.* (*Society Islands*) 1841, *p.* 60; G. *VITIFOLIUM, Richard, Tent. Fl. Abyss.* 1847, I., *p.* 64; G. *VITIFOLIUM, Royle,*

Cotton in India, 1851, *p.* 151; *G. BARBADENSE*, *Parl.* ? (*in part*), *Sp. dei Cot. t.* III.; *Piura Cotton, Spruce, Cult. Cotton in N. Peru*, 1864, *p.* 61; *G. BARBADENSE* (*in part*), *Oliver, Fl. Trop. Africa*, 1868, I., 210; *G. vitifolium, Todaro, Relaz. dei Cot.* 251–7 (*in part*), *t.* XII.; *Quebradinho Cotton in Brazil, according to Branner, Empire Brazil*, 1885, *in U.S. Dept. Agri. p.* 28; *G. RELIGIOSUM, Schumann, Mart., Fl. Bras.* (1891), XII., *pt.* III., *p.* 583 (*in part*); *G. RELIGIOSUM, Aliotta, Riv. Crit. Gen. Goss., p.* 44 (*in part*); *O. F. Cook, Weevil-Resisting Adapt. of Cotton Pl. in U.S. Dept. Agri. Bureau, Pl. Ind. n.* 88, 1906.

The Vine-leaved cotton; some of the Egyptian long staples; Antilles; Piura or Amazon; Surinam, Cayenne; St. Domingo, Guadeloupe, Barbados, &c.

This would appear to be the stock from which much of the cotton often described as Sea Island, as also the best qualities of the long-staple Egyptian cotton, and all the higher grade South American cottons may have been and are still mainly derived. It is, for example, the Piura cotton, described by Spruce as the chief indigenous cotton plant of N. Peru. In fact, it seems highly likely that this is the earliest known stock of *G. barbadense, Linn.*, though from its being occasionally recorded as found wild or in a state of complete acclimatisation, it seems preferable to retain it as a separate form rather than to merge it into the protean *G. barbadense*, of which botanically it is possibly only a variety. Moreover, in cultivation it rarely exists pure, and through hybridisation merges into *G. peruvianum*: in fact the two plants are often separable with difficulty.

Description. Leaves sub-cordate, frequently irregular, but with three (or five) ascending lobes, the central one often much longer than the laterals, more or less pilose-tomentose below; bracteoles large, slightly united below, and teeth awl-shaped; seeds black, naked, and quite free from each other. This is, in other words, a broader-leaved form *G. barbadense*, more like a softly hairy *G. peruvianum*, though the leaves are mostly only 3-lobed and the lobes broad, occasionally 5-lobed, the bottom pair being more angled than lobed. The flowers are very large, perhaps often three times the length of the bracteoles. The Surinam plant, mentioned above, has much smaller, almost pilose leaves, the whole plant being very hairy, so that I am by no means sure that it should not be treated as a new species. Berthoud-Coulon's specimen (mentioned below), closely matches the fragmentary specimen in the Linnean Herbarium, and Hassler's Paraguay

M. Smith delt, J. N. Fitch lith.

West, Newman imp.

No. 45. GOSSYPIUM VITIFOLIUM, *LAMK.*

1, Flowering shoot showing large stipules, glands, &c.; 2, entire leaf; 3, bud with calyx and (*a*) bractlets over the inner glands.

plant seems a distinct form, though closely allied to the present species. The Indian specimen examined by me in the Kew Herbarium (collected by Dr. Falconer at Saharanpur Botanic Gardens) would seem to be possessed of glands, alternating with the bracteoles, each covered by a bractlet (**f. 3**). (**See Plates No. 1** [**Frontispiece**] and **No. 45.**)

The Vine-leaved cotton may be further recognised by the following more detailed description: *Stems* perennial, diffuse spreading, often strongly angled and twisted, purple, minutely gland-dotted, when mature glabrous. *Leaves* sub-glabrous above, pilose-tomentose below and with one large gland (? occasionally three) beneath; ovate oblong, at most only sub-cordate acute or acuminate, entire (**45 f. 2**) or 3-lobed (**f. 1**), occasionally even obscurely 5-lobed, the lobes being on the apex and ascending, scarcely spreading, but crowded, linear oblong, undulating; *stipules* often large oblique, ovate acute to linear lanceolate. *Inflorescence* axillary shoots with long peduncles bearing one flower and one normal leaf (usually 3-lobed) or the shoot elongated and bearing two or more flowers and leaves; *pedicels* short and prominently warted, furrowed, ending in external glands; *bracteoles* ovate-rotund, united very slightly by their auricles, acute, deeply laciniate, the tips of the teeth almost awl-shaped; three glands within the bracteoles, in some of the forms protected by special structures named by Cook as bractlets; *calyx* large, sub-truncate or angled, many-veined, ciliate on the margin, otherwise glabrous; *corolla* almost shorter than the bracteoles, tomentose on the outer margins of the petals, convolvulate with purple claws and purplish tinge. *Fruit* embraced and almost completely enclosed by the accrescent membraneous bracteoles, ovate-rotund, shortly beaked, 3- to 5-, usually 4-valved. *Seeds* five to ten in each cell, black, naked, quite free, but bearing a long silky readily separable floss.

Central and South America.

Habitat.—Possibly originally a native of Central and South America to the Amazon basin, as also of the Lesser Antilles; recently distributed under cultivation to the Southern States of North America, the West Indies, and Africa; occasionally met with in Egypt, India, the Celebes, Madagascar, Mauritius, &c. Frequently mentioned as seen in a wild condition, but it is possible that with better and more extensive material there may be found to be two or more perfectly distinct species included under the present form. Some of the publications enumerated above, such as Merian's Surinam picture and Rumphius' Celebes plant, show the leaves too deeply 5-lobed (as in *G. brasiliense*) to be typical *G. vitifolium*, but I leave them here for the present, since this position is more correct than under any other known species.

Specimens.

Citation of Specimens.—There are a few good examples of this plant in the Herbarium of the Royal Botanic Gardens, Kew, of which the following are the more important:—CEYLON: a specimen collected by Dr. Scott which

matches exactly the next sample. INDIA: (a solitary specimen Cult. Saharanpur, Dr. Falconer, n. 286). MALAYA: Cambodia, Pierre, n. 1,043. AFRICA: Source of the Nile, Speke and Grant (said to be found near ruins of a deserted village, 1860–63); Egypt, many (described as *G. barbadense*); Senegal, (ex. herb. J. Gay—spoken of as 'Cotonier de Géorgié'); Gold Coast, specimen recently contributed by Mr. Dudgeon under the name 'Kidney cotton of Sittam, E. Akim, Ashantee,' and a second sample spoken of as native black-seeded cotton of Labolabo. MADAGASCAR: (ex Herb. Paris) collected Voy. M. de Boivin, 1847–52 (shoots long-angled, often with solitary peduncles at each joint and thrown to one side). WEST INDIES: no examples. AMERICA: Argentine (Tucuman), collected by Tweedie in 1837—'grows plentifully but cotton of little use.'

In the Linnean Herbarium there is a leaf and flower shown by me on **Plate No. 49A** which may be this species: it appears to have come from Surinam.

In the British Museum Herbarium there are in many respects the most interesting specimens of this species to be seen anywhere. In the Sloane section there is a fairly long series, but mostly in the form of leaves only, such as Plukenet's set, vol. 84, f. 87 (leaf almost entire) also 85, f. 146; (Beaufort set) vol. 132, f. 18, two specimens, one the present species, the other *G.* ? *mexicanum*, said to be from Barbados; (Petiver's set) vol. 159, f. 205, a fragmentary specimen furnished by Dr. J. Marshall from ? Virginia—mentioned in Petiver's list, the preface of which is dated 1698; lastly (Boerhaave's set), vol. 322, a specimen collected from his garden, source not stated. In the general herbarium there is a specimen from Java by Horsfield; from Egypt a doubtful specimen by Schweinfurth, n. 186; from Ecuador by Spruce (1857); Surinam by Berthoud-Coulon, n. 249 (possibly a new species); and from Paraguay by Hassler, n. 7,578 (also possibly a new species).

In the Calcutta Herbarium there are two sheets of this plant that match Falconer's n. 286 very closely; these bear as the record of their history the letters H.B.C. but no date. A third sheet that may be a hybrid between this species and *G. mexicanum* is named *G. flavescens*, but is dated November 16, 1807, and appears to have been obtained from Madras and has been recorded under Wallich's n. 1,875.

In M. de Candolle's Herbarium at Geneva there is a specimen from Jamaica collected by Murray in 1827; several sheets from Egypt such as n. 317, collected in 1834 and a somewhat doubtful specimen named 'Jumel cotton'; specimen collected M. Boissier, cult. Maloga 1837; and a plant named *G. religiosum* identified with Rohr's 'muselin' cotton.

Nomenclature.—While I have thus not discovered in any herbarium specimens of this plant recorded as procured from Mexico proper, as already stated I am disposed to think that Hernandez (*l.c.*) may have intended to indicate it as the *Ychcaxihuitl* of the Mexicans. His drawing manifests most of the more diagnostic conditions of *G. vitifolium*, though of course 250 years ago it is not likely that the plant would have been recognised as different from *G. brasiliense* or *G. peruvianum*. Hernandez speaks of this species as extremely

common in Mexico, growing in warm, damp places, especially cultivated, and he thus leaves the inference open that it may be wild. He uses, in fact, almost the same words as Marcgraf did in connection with kidney cotton. But he furnishes its vernacular name, and gives an engraving which is perhaps the first illustration of a New World cotton. Piso confused the Mexican plant of Ximenes and Hernandez with the Brazilian of Marcgraf. Wild plant.

Merian's coloured plate is a remarkably good picture, and it is significant that up to the close of the eighteenth century Surinam cotton was spoken of as one of the finest known grades. As already stated, however, I am not quite satisfied with its being treated as a synonym for *G. vitifolium*, the more so since recently collected specimens from Surinam and that in the Linnean Herbarium as well, all keep together and apart from typical *G. vitifolium*. I am not prepared, however, to assign them an independent position without better material and more precise information, though it is possible that the three mentioned may be hybrid states of *G. brasiliense*. Surinam cotton.

Rochefort ('Hist. Nat. et Mor. des Iles Antilles,' 1658, pp. 81–2) is perhaps the earliest writer on the cotton plants of the Antilles. He describes two forms: a tree cotton called *manoulou-akecha* and a procumbent plant that spreads on the ground like a vine without supports. The last mentioned produces the finest cotton. Antilles.

Père Labat ('Nov. Voy.' 1724), who explored with great care the 'Isles de l'Amérique,' gives many interesting particulars of the cotton cultivation of Guadeloupe, and furnishes an engraving of the plant. This shows the seeds free and naked, but the leaves as rigidly 5-lobed, and more like those of *G. brasiliense* than the present species. His description, however, gives the leaves as 3-parted and 'big, like those of a vine,' and thus denotes *G. vitifolium* sufficiently well, but it may in passing be added that the engraving does duty a little later as an illustration of the cotton of Senegal (Labat, 'Nouv. Relat. de l'Afrique Occ.,' vol. III., 262–9, pl. 262), and it may therefore have been designed without any idea of specific distinctions. Labat tells us that there were cultivated in Guadeloupe two chief cottons, the black- and the green-seeded. Speaking of cultivation, he says the 'trees' are cut down every two or three years, and this is held to improve the staple as well as the yield, since the shoots sprout freely The cotton, he adds, much surpasses that of the Levant in whiteness, fineness, and length. The black-seeded cotton of Guadeloupe, in Labat's time, was thus a perennial. Guadeloupe. Pruned cotton.

Frontispiece.

One of the early pictures of the plant here accepted as *G. vitifolium, Lamk.*, (or *G. barbadense, Linn.*) is the beautiful illustration given as the **frontispiece** to this work. It was painted by the great floral artist G. D. Ehret, is in the possession of the British Museum, and has been reproduced here by the kind permission of the Keeper of the Herbarium, Dr. Alfred Barton Rendle. Ehret married Philip Miller's sister, and it is thus highly likely that the plant sketched was being grown in the Chelsea garden. There would seem little doubt, in fact, that it represents one of the early stocks of the black-seeded cottons of South America and the West Indies that attracted attention prior to the discovery of the Sea Island stock. The painting is on parchment, and bears the date of 1766. It is a work of art to which the photographic reproduction (though admirable) does not give full justice. The lower leaves are seen to be 3- to 5-lobed, certain ones near the middle of the bush are ovate oblong, entire, the uppermost 3-lobed, the lobes linear-oblong. The fruit is ovate, 4-valved, not the linear-oblong acuminate 3-valved fruit of *G. brasiliense* and *G. barbadense, var. maritima.* In fact, the drawing represents to some extent the condition of some of the longer staple Upland cottons of the United States of America, and brings to mind also some of the Egyptian cottons of to-day.

Black-seeded cotton.

Rumphius, who lays stress on the abundance of warts on the petioles and veins, remarks that it is plentful around the houses in Tamboek in the Eastern Celebes, and had been lately brought to Amboina.

Warted branches.

Lamarck's diagnostic characters for this species are: leaves palmate, like those of a vine, lobes 5, acute, uniglandular below, and the bracteoles deeply toothed. That description would very possibly be applicable to half the cultivated cottons of the world. He adds, however, that the branches are almost glabrous; the petioles covered with tuberculed points; the leaves deeply cut into 5 ovate-lanceolate very pointed lobes, and glabrous below, with a gland on one of the nerves; flowers large yellow with purplish claws. There would seem little doubt that Lamarck was led to describe the leaves as deeply 5-lobed, through his having accepted Plukenet's plate 188 f. 2 as exemplifying *G. vitifolium.* But he was not quite certain of that synonym, and since there seems little doubt the figure in question is *G. brasiliense,* it has to be excluded, thus leaving the description less emphatically 5-lobed. The plant he described and named grows, Lamarck tells us in the Celebes, is cultivated in the

Lamarck's position.

Isle of France (Mauritius) and in several parts of South America. He then adds that it had been sent to him by M. Sonnerat.

Of *G. barbadense* Lamarck furnishes next to no information—in fact, only republishes the Linnean diagnostic characters, and then adds that it grows naturally in Barbados. But commenting on his *G. glabrum* (doubtless one of the forms of Bourbon cotton), he remarks that he was uncertain whether he should not bring it under *G. barbadense*. It is thus quite clear that he confused *G. barbadense*, and that the plant which he described as *G. vitifolium* was founded to include at least some of the cultivated states now treated as forms of *G. barbadense*.

Cavanilles' position.

Cavanilles accepted the species *G. vitifolium* as defined by Lamarck, but modified the description. The upper leaves, he says, are 3-lobed, the lower 5-lobed and sometimes sub-tomentose, the corolla almost shorter than the bracteoles, convolute, the limbs maculate with purple claws, calyx 5-dentate, and the seeds ovate black (his plate shows them quite free from each other and devoid of any trace of fuzz). A note added by D. Thouin is to the effect that there are six glands on the flower, three outside and three inside the bracteoles. Cavanilles seems, in fact, to have established the species *G. peruvianum* with the express purpose of meeting the position of fuzzy-seeded forms of this assemblage, but it is remarkable that he should have said *G. barbadense* was unknown to him. The explanation, doubtless, is that *G. vitifolium* embraced all the cottons in question.

Willdenow (in 'Linn., Sp. Pl.' 4th ed. III., p. 804) accepted the species as defined by Lamarck and as amended by Cavanilles.

Roxburgh's *G. vitifolium* ('Fl. Ind.' III., 186) is *G. peruvianum, Cav.*, but his MS. plate named *G. vitifolium* (n. 1,490) is *G. brasiliense*. Wight ('Ill. Ind. Bot.' I., t. 28 B) confused this plant with Sea Island cotton, as indeed did most subsequent writers. (Cf. Wight, 'American Cotton at Government Cotton Farm of Coimbatore,' 1843).

Cultivation

Separate recognition essential.

Races.—If *G. vitifolium* has any claim to having been seen in a truly wild condition, and I am disposed to think it has, then it is highly likely that *G. barbadense* is but one of its many cultivated states; the finer grades would be the true Sea Island, the less important the better grades of Egyptian long staple, with the modern Maragan, Surinam, St. Domingo, Cayenne, &c., as still other grades. It is accordingly, from a commercial point of view, important that

this plant should be distinguished from the Sea Island and also from the Bourbon cottons, to both of which it is closely allied.

The fact (already mentioned) that Surinam cotton was famed some time prior to the first mention of the Sea Island staple; and the still further fact that numerous writers allude to the cotton of the southern of the United States of America as having been improved by the importation of Mexican cotton, supports belief in this being probably one of the chief ancestors (or at all events representing one of the chief ancestors) of some of the best cottons of the world.

The descriptions given by the authors just mentioned, and by most, if not all, the modern writers as well, do not, however, agree in certain respects. Still there seems little doubt the passages above cited and others that could be added were intended to denote the plant here indicated.

Obscurity and confliction.

Lamarck described *G. vitifolium* as having leaves 5-lobed, and Cavanilles amplified that view by stating that the leaves on the lower part of the stem were 5-lobed, those of the younger twigs 3-lobed. *G. vitifolium* is, however, in point of foliage often almost inseparable from *G. brasiliense*, but the seeds are free from each other. It is therefore, instantly removed from Todaro's sub-section *Synspermia* (into which that author placed it) and carried to a position alongside *G. barbadense*, *Linn.* Roxburgh mistook *G. peruvianum* for this plant, and his MS. plate is undoubtedly *G. brasiliense*, not *G. vitifolium*. The obscurity and confliction that prevail, regarding it, thus very largely proceed from the errors of certain botanists in confusing it with *G. brasiliense* and *G. peruvianum*.

Rohr, who over a century ago lived in the Danish West Indies, made, as he tells us, a tour in 1790 of all the neighbouring islands and mainland of South America in order to study cotton cultivation and to collect seed for trial in Sainte-Croix. He was accompanied by a Dr. P. Dunkan, who finally went to Scotland to investigate cotton spinning and to show the assortment of samples of cotton collected by himself and M. Rohr with a view to the spinners selecting the best sorts for their trades. Rohr and Dunkan procured, among many others, nine forms of cotton which the former places in his section (A) (namely 'Cottons whose seeds are rough and black'). These nine cottons I have little doubt are one and all forms of *G. vitifolium* or of *G. barbadense*, whichever scientific name it is preferred to use. One Rohr calls 'Wild Cotton'—the plant which he says is by the French designated 'Naked Cotton' and in

Nine forms.

Wild cotton.

Jamaica 'Withy Wood,' because of its long flexible branches. It is found on most plantations, but though never seen by Rohr (as he explains) in a truly wild condition, is always left to grow as it likes because of the saying 'Cotton is always cotton.'

Green crown.

It would take too much space to review all the forms described by Rohr: one or two must therefore suffice. The 'Green Crown Cotton' or 'Fine Cotton'—the 'Rum and Sugar Cotton' of Martinique—is called 'green crown' because of the tuft of fuzz on the apex of the seed, which when young is of that colour, but with age darkens into brown. The 'Green and Red Sorrel Cottons' of Spanish-Town are so called because of their being suggestive of the Green and Red Sorrel (*Hibiscus Sabdariffa*). Jean Rengger introduced these into Sainte-Croix in 1787. But the cotton upon which Rohr expends his greatest descriptive efforts is that called 'Year Round Cotton' so named by the English, so our author explains, because the harvest commences in one year and is carried into the next. He speaks of two varieties, the coarse and the fine. These have for a long time been grown in the Danish islands. They are sometimes called 'Rum Cottons' because a sackful as desired could always be disposed of to the village traders in exchange for rum. Rohr further explains that the cottons which for convenience he had separated as distinct forms under the names 'Wild Cotton' 'Cotton with a prominent beak' and 'Cotton with a hooked beak' were in reality only special forms of 'Year Round Cotton.' The true year round cotton has always a little tuft of fuzz below and around the beak. It bears from November to March and again from June to September. It was largely cultivated, Rohr remarks, in Montserrat, under the name of 'Loaf Cotton.' The so-called 'Fine Year Round Cotton' came originally from Porto Rico, having been furnished by M. Colbiorson in January 1790, but it is possibly a form rather of *G. purpurascens* than of *G. vitifolium*. Lastly Rohr tells us of still another form called 'Old Bess,' a name supposed to have been given to it from the name of the lady who first cultivated it. It is a large bolled cotton and gives an abundant return of inferior wool.

Year Round cotton.

Rum cotton.

Old Bess.

Now I have gone into these details because Rohr is perhaps the earliest planter-author who has left us a detailed record of the cottons actually grown, during the early endeavours of Europeans at cotton cultivation in the West Indies.

Three points stand out clear regarding every one of these supposed *G. vitifolium* forms, viz:—(*a*) all were perennials and often

attained a height of 8 to 12 or even 16 feet. (*b*) None of them were noted for producing a staple of an exceptional length. (*c*) They were not then regarded as by any means the best cottons. In fact the cotton most highly esteemed and most frequently cultivated was Guiana or Brazilian kidney cotton. Lastly (*d*) the seeds were not completely naked.

It is impossible to believe therefore that any of the forms described by Rohr, which I place under *G. vitifolium*, and the others which I have carried to *G. peruvianum*, could have had a floss of two inches in length, since had a staple existed so much above and beyond all the others as that, it would certainly have called for very special consideration. Indeed from Dr. Dunkan's report of his visit to Scotland it would almost appear as if, at that period, length was less important than purity and fineness.

Perennial stocks.

In the Danish and all the other islands of the Lesser Antilles, between 10° to 20° N., cotton could be grown throughout the year. It was only when the high grade staples were carried beyond the 25° and up to the 34° N. latitude that it became imperative to possess annual stocks that from sowing to harvest could mature their crops within the hot summer months and be thus off the fields before the frosts of winter supervened.

West Indian *versus* Levantine cottons.

Poiret (' Dict. des Scien. Nat.' vol. xi., 1818, pp. 55–7), in a long article on the cultivation, &c., &c., of cotton—a review more or less of Rohr's opinions—says in a concluding chapter on ' Trade ' that the cottons are commercially divided into ' Island Cotton ' and ' Levantine Cotton,' making thus, doubtless, a direct reference to the West Indies. The former, he adds, is distinguished by such names as Guadeloupe, Saint Domingo, Cayenne, Barbados, &c. The cotton called ' Maragnan ' is considered as the best of the Island cottons; then comes Surinam, next Cayenne, then St. Domingo. Guadeloupe, though inferior to those mentioned, is largely used in the manufactures of Rouen. How much all this has changed is one of the marvels of the modern cotton trade, and possibly we should look to the Maragnan as having given the first direct indication of the improvement of the special races of *G. barbadense*.

It is unfortunate that no modern writer can be discovered who has described with as much detail as Rohr did, a century ago, the forms of this particular species that are at present grown and the methods pursued in their cultivation, in the Antilles and in South America.

I have accordingly to leave this theme in a very imperfect condition, but when it has been written fully by others in the future, it will be interesting to contrast with Rohr's forms of *G. vitifolium* those of modern cultivation. From what has been said, however, it would appear fairly certain that a complete change has taken place; in other words that most of the plants described by Rohr very possibly no longer exist. The following note, abstracted from Schumann's account of this species ('Mart., Fl. Brazil,' XII., pt. III., p. 583), may therefore be usefully added as denoting the centres of production in South America, and it may be observed that although he does not call the plant Sea Island cotton, his plate (t. 114 of *G. barbadense*) is much nearer to the Sea Island type than to most of the forms of *G. vitifolium* of other writers. South America.

I have seen it, says Schumann, in the province of Pernambuco, near Beberibe (Schenck, n. 4,116, collected in the province of Minas Gëraes; Widgren, n. 1,332, in the province of S. Paulo Serra de Caracol; Mosén. n. 1,121, near Rio de Janeiro; Niederlein, n. 33, in Venezuela, near Caracas, &c.). He then adds that it is cultivated especially in the islands of the Antilles and in Central America, more rarely in South America and in the tropical regions of the Old World.

40. G. BARBADENSE, ***Linn.,*** *Hort. Upsal* I. (1748), 204; *Sp. Pl.* 1*st ed.* II. (1753), *p.* 693, 2*nd ed.* (1763), *p.* 975; *Plukenet, Alm. Bot.* (1696), *vol.* II., 172 *& Phyt. t.* 188, *f.* 1. (*excl. all syn.*); *Miller, Gard. Dict.* 8*th. ed.* (1768), *n. 2*; *Lamk., Encycl. Meth. Bot.*, 1786, II., 134; *Cav., Diss.* (1785), *p.* 315; *Swartz, Kongl. Vetensk. Akad., Handl.*, XI., *n.s.* (1790) 20–5; *Willd., Linn. Sp. Pl.*, 4*th ed.* (1800), III. 806; *Poir., Dict. des Scien. Nat.*, 1818, XI., 38; *DC., Prod.*, 1824, I. 456 (*excl. syn. Roxb.*); *Descourtilz, Fl. des Antilles* (1827), IV., 209 *t.* 278; *Macf., Fl. Jam.* (1837), I., 73; *Wight, Ill. Ind. Bot.* (1840), I., 57–64, *t.* 28 B.; *Sea Island* (*in part*), *Royle, Cotton in India*, 1851, *p.* 145–7, *t.* III., *f.* 3; *Triana & Planchon, Fl. Novo-Granatensis* (1862), *p.* 170–1; *Grisebach, Fl. British W. Indies* (1864), 86; *Sea Island Cotton, Spruce, Cult. of Cotton in N. Peru*, 1864, *p.* 69; *Parl., Sp. dei Coton.* (1866), *p.* 48 (*in part*), *t.* III.; *Tod., Relaz. Cult. dei Cot., p.* 234 (*in part*); *C. Müll., Walp., Ann. Bot.*, VII. (1868), 414 (*follows Todaro and gives two varieties, viz., Jumelianum and degencratum*); *Hemsley, Biol. Centrali-Americana* (1879–88), I., 123; *Max. T. Masters, Fl. Br.*

Ind. (*in part*), I., 347; *Watt, Dict. Econ. Prod. Ind.*, IV. (1890), *pp.* 15–25; *Schumann, Martius, Fl. Brazil*, XII., *Pt.* III. (1886–1892), 582–3, *t.* 114; *Heuzé, Le Plant. Indust.*, 1893, I., *pp.* 140–1; *Engler, Die Pfl. Ost-Af. &c.* 1895, *p.* 384; *Evans, in United States, Bull., n.* 33 *of* 1896 (*in part*); *Sadebeck, Kulturgew. der deut. Kolon., &c.*, 1899, 304–7; *Engler and Prantl, Pflanzenfam.*, III., *n.* 6, *p.* 52, *f.* 24 (*after Parl.*); *Small, Fl. Southeastern U.S.*, 1903, *p.* 778; *Aliotta, Riv. Crit. Gen. Goss.* (1903), *pp.* 15–18 (*in part*).

This embraces the forms of the so-called Sea Island Cotton, in fact, most of the Long Staple Cottons of the United States of America and of Egypt. Its separation from *G. vitifolium* has been made from industrial rather than botanical reasons. By some authors *G. barbadense* has been made, but incorrectly, to include also the Bourbon cottons.

Description.

A shrubby perennial, found only in cultivation and usually treated as an annual; glabrous, or nearly so, except on the leaf stalks and veins of the leaves and the under surfaces of young leaves; leaves fully half or more segmented into 3 to 5 usually spreading ovate oblong acuminate lobes, central one not materially larger than the others, but bearing on the vein below a distinct gland (or occasionally also the lateral veins may have glands); peduncles usually shorter than the petioles, rigid and strongly angled; flowers not twice the length of the bracteoles; bracteoles free, ciliate and eglandular; capsules ovate acuminate, 3- or 4-valved; seeds free from each other, ovate, beaked, smooth, black, naked, except a small tuft of hair at the apex; wool long, silky, pure white, and readily separable from the seed. **(See Plates Nos. 45 and 46 A.)**

It may now be useful to furnish a more detailed description of this plant as accepted by me: *Stems* round, often blue-black, smooth, glabrous, interruptedly angled; *leaves* in texture thick, smooth, usually drying in the herbarium into greenish-grey, not the brown colour so constant in *G. brasiliense*, often with a purple tinge when fresh (especially along the prominent midribs, which look as if composed of three folds), in size the leaves are 3 to 5 by 2½ to 4 inches, in main shape ovate oblong, cordate, ½ segmented into 3–5 lobes which normally ascend, ovate oblong, acuminate, the sinus thrown up in a fold, glabrate, with a few hairs on the veins (the tendency to become glabrous, to have large broad cordate leaves, with 5 spreading lobes, marks the advance from *G. vitifolium* through *G. barbadense* to the variety of this species distinguished as *maritima*); *stipules* linear, ovate, acute, oblique; *petiole* nearly as long as the leaf, often with a few long hairs. *Inflorescence* axillary, solitary, on special leafy shoots that become much elongated; *pedicels* about 1 inch long, angled in maturity,

No. 46. GOSSYPIUM BARBADENSE, *LINN.*

(A) Type of species in Sloane Herb. of B. M. (Pluk. series, Vol. 100, f. 105) : f. 1, mass of seeds and wool ; (B) reproduction of Pluk. Alm. Phyt. t. 188, f. 1, the fruit and lower leaf being imaginary ; (C) specimen of Sea Island Cotton—average modern type given to allow of comparison—f. 2, pod ; f. 3, seed with its floss.

thrown extra axillary and almost opposite the leaf, but do not form glands within the cordatures of the bracteoles; *bracteoles* fairly large, glabrate, with pale coloured veins, ovate oblong, 5–7, not very deeply but coarsely toothed, cordate, attached to the calyx tube but only very slightly united or quite free. *Flowers* medium sized, often not quite double the length of bracteoles, occasionally much larger; *petals* woolly on outer margin, rotating to right, pale yellow with purple tinge, diffused rather than maculated purple claw, tube short but firmly formed. *Calyx* wide campanulate, crenate, with large rounded teeth, many-veined, and with rows of glands between. *Fruit* ovate-acuminate, most often 3-, more rarely 4-valved, opening fairly widely, but valves not reflexed; *seeds* 6 to 9 in each cell, ovate, beaked, smooth, free from each other and almost quite naked; *wool* long silky, and very fine, easily separable from the seeds.

Antilles, South and Central America.

Habitat.—Hemsley says of this species, 'Cultivated and wild, probably indigenous in America'; and Schumann (Martius, 'Fl. Bras.') remarks, 'specially cultivated in the islands of the Antilles and in Central America, more rarely in N. America and the tropics of the Old World.' Tussac ('Flora of the Antilles') speaks in general terms of an indigenous species, with very superior floss, and then proceeds to describe four species as cultivated. These seem to be *G. purpurascens*, *G. hirsutum*, *G. brasiliense*, and *G. Nanking*. His plate is most probably *G. vitifolium*, and may therefore have been the indigenous plant to which he alludes. Rohr, who a century ago lived in the West Indies and wrote a book on cotton ('Obs. sur la Cult. du Coton,' 1790, et ed. Gall., 1807), makes no direct mention of *G. barbadense*. Koster ('Trav. in Brazil,' 1816, p. 365) in a footnote asks, 'Might not the Sea Island seed be sent for, and a trial of it made?' This observation was in connection with his statement in the text that the cotton of Pernambuco never succeeded near the sea coast. Grisebach observes ('Fl. Br. W. Ind.,' 1864, p. 86) that it 'is said to grow spontaneously in the West Indies; I have examined only two West Indian forms.' But as already remarked, the specimens seen by me in Grisebach herbarium appear to be *G. brasiliense* and *G.* ? *mexicanum*, and, therefore, neither of them *G. barbadense*. Very possibly, however, *G. barbadense* may have been originally cultivated in the Antilles, and within the past two centuries been developed into several distinct races, and its cultivation thus extended throughout the whole of the West Indies, and more recently along the maritime tracts of the Southern States of North America, also of Central and South America. Its further cultivation in Egypt, Africa, India, and elsewhere, has been vigorously attempted, but mostly with indifferent success.

Specimens.

Citation of Specimens.—In Kew Herbarium:—from BARBADOS: Forester, example presented by the Corporation of Liverpool; ST. KITTS, collected by Grisebach, n. 19 (fragmentary and possibly *G. brasiliense*); BRITISH GUIANA, by Jenman, n. 5,139, June 1889; MARTINIQUE: by L. Hahn in 1870 (an almost glabrous sample); ST. THOMAS: by Eggers, n. 242; TRINIDAD: by Fendler, n. 226; BAHAMAS: by A. H. Curtiss, n. 135 (an exceptionally hairy sample); ISLAND OF MARGARITA (Venezuela): by Millar and Johnston, n. 207; SOUTHERN NIGERIA: by J. H. Holland, n. 250; ZAMBESI: Tette, by Sir J. Kirk; EGYPT (Upper): by W. Schimper, (in herb. J. Gay); MEXICO: Guaymas, by Dr. E. Palmer, n. 110 (1887); PARAGUAY: by E. Hassler, n. 484 'Culta et quasi-spontanea ex numero'; GUATEMALA: by Bernoulli and Cario, n. 3,100, December 1866.

In the British Museum Herbarium there are many specimens of great interest that supplement those in Kew very materially. Of these special mention has to be made of the Sloane collections. These will, however, be discussed in detail in a further paragraph (p. 269–270). EGYPT: Damietta, Schweinfurth, 1888; Wilkinson 1834; AFRICA: Angola, Welw., nn. 5,229, 5,230, and 5,232; AMERICA: S. Florida, Rugel, n. 93A; MALAYA AND POLYNESIA: Java, Horsfield; Pitcairn Island, 1834; WEST INDIES: Porto Rico, Sintenis, n. 6,856 (a very doubtful specimen).

In the Calcutta Herbarium there is a specimen that appears to be this plant named by Kurz as *G. acuminatum* and recorded as procured from H.B.C.

In M. de Candolle's Herbarium, Geneva, there is a sample collected by M. Morrenhout in Tahiti in 1835 that seems to be Tahiti Sea Island cotton.

Nomenclature.—Much diversity of opinion prevails as to the determination or rather limitation of this species. It has been confused with two or three other cottons, and is often met with so completely hybridised, that its separation from *G. vitifolium*, *G. brasiliense*, and even *G. peruvianum* becomes difficult. Its great merit as a staple, and the part which it has apparently taken in the production of all the finer grade cottons of modern commerce, render it imperative that the attempt should be made to fix its identity with as much precision as may be possible.

The type.

There can, however, be little doubt as to the botanical type of the species. It was founded by Linnæus on the description and plate given by Plukenet (who lived from 1642–1706)—'an annual cotton with 3-lobed leaves met with in Barbados,' and which, therefore, is inseparable on that definition from *G. vitifolium* above. In the second edition of the 'Species Plantarum,' Linnæus added the information that the leaves below had three glands, but it seems doubtful whether this supplementary feature is a constant characteristic or may not rather be an acquired one through hybridisation or adaptation to insect visitants. Plukenet's specimen is in the Sloane Herbarium of the British Museum (vol. 100, f. 105 and Ray 1064–1), and is, there-

No. 47. GOSSYPIUM BARBADENSE, *LINN.*, VAR. MARITIMA, *WATT.*

(A) River's Sea Island: 1, seed with floss: 2, bracteole: 3, transverse sections of 3-celled pod: and 4, vertical section; (B) flower and fruit of Black Rattler, Sea Island, grown at Washington from seed obtained from S. Carolina.

fore, the absolute type of the species as originally conceived. It is reproduced here (**see Plate 46 A**). It was fairly accurately represented by Plukenet's figure, also for convenience reproduced by me (**Plate 46 B**), except that the fruit shown is not present on the specimen, though a tuft of the seeds and wool, presumably taken from the fruit (**Plate 46 A, f. 1**) is attached, and these are fully in accord with the usually understood condition in this species, though they are not described by either Plukenet or Linnæus. The leaves are distinctly 3-lobed, the lobes ascending from an imperfectly cordate base, not 5 spreading from a cordate auriculate base, as shown by Parlatore and other botanists who have published plates of what they supposed to be this species. It would in fact seem fairly certain that most authors have confused *G. vitifolium*, if not *G. brasiliense*, with the present plant. And this confusion goes back even to Plukenet himself, so that while accepting his t. 188, f. 1 (**Plate 46 B**) as the type of the species (as Linnæus did), we must exclude all the synonyms cited by Plukenet.

Other historic specimens.

There is no specimen of *G. barbadense, Linn.*, in the Linnean Herbarium, London, though two plants are in Linnæus' hand-writing named '*barbadense?*' (**see Plates Nos. 19 A and 24 C**). It is thus certain that Linnæus had a very incorrect conception of Plukenet's plant; moreover, Plukenet must have had other specimens before him than the actual type. In the Sloane Herbarium, for example, there are (besides the type) examples of this or some allied plants that it seems desirable to mention in this place, even although not one of them could for a moment be accepted as being Sea Island cotton, as presently known to us:—In vol. 56, f. 192, there is a specimen (one of a series of plants) said to have come from the King's Garden, Montpelier. The leaves are deeply 5-lobed, and on the sheet on which it is mounted has been recorded '*G. arboreum caule levi, Pin.*' I am not prepared to accept this as being *G. barbadense*, though I can suggest no other name for it. In vols. 84, f. 87, and 85, f. 146, &c., are softly pilose 3-lobed leaves of what I think may be *G. vitifolium*. These belonged to Plukenet and were probably accepted by him as being identical with the plant in vol. 100, f. 105.

In vol. 132, f. 18 (Duchess of Beaufort's set of plants) there is a specimen said to represent Plukenet's 'Phyt.' t. 188, f. 1, but which is nearer to the leaves in his herb. just mentioned. On the same sheet is mounted a specimen said to have been obtained from Barbados that seems to me to be *G. mexicanum*—certainly not *G. barbadense*. Both these were doubtless cut from plants grown at the Badminton

gardens about the close of the seventeenth century, and very possibly were raised from seed procured from the West Indies.

Barbados specimens.

In vol. 184, f. 28 (Petiver's herb.) will be found a specimen of cotton, one of a general herbarium obtained from Barbados and Jamaica. This matches in some respects Plukenet's type specimen (vol. 100, f. 105), but is perhaps more nearly related to the leaves in vols. 84 and 85, in other words it is nearer to *G. vitifolium* than *G. barbadense*. It is, however, the oldest authentic specimen that has any chance of having come from Barbados, and it most emphatically is not *G. barbadense* as known to us in the modern Sea Island cotton. Rohr was for some years (toward the close of the eighteenth century) a resident in the Danish island of Sainte-Croix. During that time he devoted much attention to the study of the species of *Gossypium* there grown. He makes no mention of any plant that could be identified with the Sea Island cotton of modern commerce.

Further it may here be pointed out that Richard Ligon ('Hist. Barbados,' 1657) was one of the earliest writers who described the island of Barbados. He gives many interesting particulars of the natural products and industries, especially sugar-cane planting, but has very little to say regarding cotton. He makes no mention of its being wild, but states that, while much land was available for cotton (p. 94), he had seen only five acres (p. 22) under the crop. Incidentally he alludes by name to cotton-wool in several places (pp. 24 and 40) as one of the new products that the merchant ships which have begun to visit the island have commenced to carry away, but gives no sort of justification for the belief that on the island a specially meritorious cotton existed, previous to the European settlers, such as the plant which subsequently came to be called *G. barbadense, var. maritima.*

Sea Island a modern stock.

Such then in brief are the historic specimens of this, the most valuable of all cottons. They point, I venture to think, conclusively to the Sea Island cotton being a modern development, and further to the conviction, brought home by other circumstances, namely, that there is little or no evidence in support of the belief that it is indigenous to Barbados nor in fact to any of the West Indian Islands.

Hybrid.

The plant is so closely associated with *G. vitifolium* as to suggest its indigenous habitat being somewhere in South America. But it is highly probable the modern stock is a hybrid.

Mention has just been made of the Duchess of Beaufort and of the Badminton gardens. It will be recollected that these gardens are

exhibited as having very possibly cultivated *G. hirsutum*. It is thus very likely that in both instances they played an important part in making known the merits and in distributing the original supplies of these—the two most valuable of all cotton plants.

Lamarck, commenting on *G. barbadense*, says the three glands appear the most diagnostic character of this imperfectly known plant; then he adds that it grows naturally in Barbados. Cavanilles, while repeating the usual description, admits that the plant was not known to him. Poiret (*l. c.*) speaks of it as an American shrub with glabrous stems, the lower leaves of which are 5-lobed and the upper 3-lobed, and the flowers very large yellow. Poiret is more emphatic than Lamarck and Cavanilles, but still makes no mention of the floss being the longest and finest of all the cottons. Swartz says that it is the cotton tree of the West Indies, but, as already observed, there is little to support that belief. Aublet remarks that in Cayenne they make with the seeds of this species a pectoral and refreshing emulsion and extract from them an oil—still no allusion to the great merit of the fibre. The plant, described by Roxburgh under the name of *G. barbadense*, and of which he prepared two admirable MS. drawings nn. 425 and 1,499), is, as he says, much more like Bourbon cotton —is certainly not Sea Island. Macfadyen gives a short description in which he remarks that the upper leaves are 3-lobed, the lower ones 5-lobed and triglandular, thus reversing Poiret's description, but he adds that he had not met with it in Jamaica (1837).

No mention of long floss.

Triana and Planchon placed all the known cottons under this specific name and formed four varieties:—(a) *vitifolium* (= *G. barbadense, Miller*; *G. vitifolium, Lamk.*; *G. brasiliense, Macf., and G. peruvianum, Cav.*); (b) *hirsutum* (= *G. hirsutum, L.*; *G. punctatum, Thon. et Schum.*; *G. punctatum, β acerifolium, Guill. et Perrot.*); (c) *acuminatum* (= *G. acuminatum, Roxb., or Fernambuco cotton*); *and* (d) *nigrum* (= *G. nigrum, var. punctatum, Webb*). Grisebach, while speaking of *G. barbadense, Linn.*, remarks that 'it is said to grow spontaneously in the West Indies: I have only examined two West Indian forms.' There are only two plants in Grisebach's herbarium (preserved at Kew), and these, as already observed, appear to be *G. brasiliense* and *G. ? mexicanum*, so that very possibly *he* also had not seen Sea Island cotton from the West Indies so late as 1864.

Wight (*l.c.* p. 63) mentions an interesting story. He deals with this species and also *G. vitifolium* in one and the same paragraph, but

Origin of Sea Island.

apparently while regarding both as yielding the so-called Sea Island staple, did not consider them as botanically the same species. He says they were with much difficulty introduced into N. America owing to the shortness of the summer season. 'The former (Sea Island), indeed, could not be established until the fortunate occurrence of a very mild winter permitted the roots to live through it and produce an early crop of fresh shoots in the spring. These bore and ripened a crop, the seed of which was found sufficiently hardy to resist the cold of spring, and matured a crop of excellent cotton in the course of the succeeding autumn. The produce was a variety intermediate between the Pernambuco and Barbados or Bourbon cottons; having the long staple, smooth black seed, and 5-lobed leaves of the former, with the free or detached seed of the latter. The peculiar and very superior qualities of this kind are attributed to its growing in a soil highly calcareous, and strongly impregnated with salt, aided by the influence of a saline atmosphere.' Then, adds Wight, 'all attempts to introduce this kind into India have so far failed.'

Pernambuco × Barbados.

Introduction into the States.

Although it is known that much intimacy existed between the early West Indian and American colonists, still the first direct mention of the conveyance of cotton seed from these islands to the mainland occurs in the year 1785. I have been told (though I have not been able to confirm the statement) that there is an older record regarding Charleston, in which mention is made of cotton being sent from the West Indies to America in 1714. It is recorded of 1785, however, that what appears to have been Sea Island cotton was first produced in Georgia from seed obtained from the Bahamas. In 1789 we next read of cotton seed, possibly Sea Island, having been sent from Jamaica to Georgia, but there seems to be some confusion, since it is at the same time spoken of as 'Pernambuco cotton.' This much, however, appears fairly certain—namely, that the cotton first exported from the United States went from Virginia and N. Carolina, and was accordingly not likely to be anything but Levant cotton—it certainly could not have been Sea Island—so that it is perhaps safe to infer that the United States of America obtained their stock of the Sea Island plant very possibly through the West Indies, and that too so late as the middle of the eighteenth century.

Surinam cotton.

There would seem no doubt, however, that South America and the Antilles were growing a superior cotton closely akin to, if not identical with, much of the so-called Sea Island cotton of to-day, long anterior to its introduction into the United States. Surinam

cotton was, for example, famed even in the middle of the seventeenth century, and as a result doubtless of the early European traffic of India and the Malaya with South America, the self-same plant came to be figured and described by Rumphius as cultivated in the Celebes, prior to any definite knowledge of its introduction into the United States. In the Linnean Herbarium there is a solitary leaf and flower not described by Linnæus, but which in his own handwriting bears the word 'Surin' as if abbreviated for Surinam. (**See Plate No. 49 A.**) I hesitate to definitely name that fragment, but think it stands every chance of being either *G. vitifolium* (see p. 255), or possibly *G. brasiliense* (see p. 295). The small flower and fimbriate teeth of the bracteoles would favour the former. Later on when we learn of the efforts put forth to improve the stock of the Southern States, repeated mention is made of the valuable results obtained with Mexican plants. All this has been narrated already, under *G. vitifolium*, but its importance cannot be over-stated, since to trace out the nativity of a cultivated plant very often means to discover the environment essential to secure successful production.

Not indigenous in the West Indies.

G. barbadense, as we know it to-day, may have been developed by cultivation in the West Indies; but if so, the original stock most certainly was not indigenous to these islands, and the plant, as now recognised, was unknown to the early West Indian botanists. This belief, then, gives a flat contradiction to the oft-repeated recommendation for an extended production in the West Indies, on the ground of the plant being there indigenous. This does not, however, in any way gainsay its successful acclimatisation in these islands. It has, in fact, recently been successfully grown in some of them. It is therefore surprising that, while historic and botanic evidence combine in so remarkable a fashion to isolate *G. vitifolium* and the cultivated states of the so-called *G. barbadense*, one of the most recent botanical writers of the United States, Dr. Walter H. Evans, should have been led to publish as indicative of *G. barbadense*, a 'compiled description,' as he calls it, that embraces the characteristics of all the following forms—'*G. barbadense, Linn.; G. frutescens, Lasteyr; G. fuscum, Roxb.; G. glabrum, Lam.; G. jamaicense, Macf.; G. javanicum, Blume; G. maritimum, Tod.; G. nigrum, Hamilton; G. oligospermum, Macf.; G. perenne, Blanco; G. peruvianum, Cav.; G. punctatum, Schum. and Thon.; G. racemosum, Poir.; G. religiosum, Parl.; G. vitifolium, Roxb.*, and perhaps others.' Some of the above are doubtless synonyms of *G. barbadense*, others

I have failed to identify, while still others can only be retained in that position if all the cultivated cottons of the world be regarded as constituting but one species.

Sea Island as a commercial fibre.

When we first make acquaintance with Sea Island cotton as an important commercial fibre, the plant is found to have departed materially from the botanical characteristics of *G. barbadense* as originally defined and illustrated by the early writers. There have, in fact, come into existence at least two chief grades of the staple, the separate recognition of which led Todaro to establish his *G. maritimum* and other allied forms. The plant has become more vigorous, the leaves, when fully formed, very large and often 5-lobed, in shape approximating very much more closely to *G. brasiliense, Macf.*, than to the original condition of *G. barbadense, Linn.*, as defined above.

Twelve Hybrids.

To some extent in explanation of this state of affairs, Dr. Aliotta (*l.c.* 28–55) has endeavoured to distinguish eight separate forms that he regards as hybrids of *G. barbadense* × *G. hirsutum*, and four more which he treats as hybrids of *G. barbadense* × *G. religiosum*. Under these he assorts many obscure and doubtfully distinct forms treated as species or varieties by Todaro and others. It may be useful to exhibit these twelve supposed hybrids by name:—*First Series*—1. *G. maritimum, Tod.*; 2. *G. maritimum, var. Jumeliana, Tod.*; 3. *G. maritimum, var. degenerata, Tod.*; 4. *G. maritimum, var. polycarpa, Tod.*; 5. *G. maritimum, var. pallidiflora, Tod.*; 6. *G. hirsutum, var. Hardyana, Tod.*; 7. *G. hirsutum, var. intermedia, Tod.*; *and* 8. *G. Figarei, Tod. Second Series*—9. *G. acuminatum, Roxb.*; 10. *G. barbadense, var. acuminata, Mast.*; 11. *G. peruvianum, Cav.*; *and* 12. *G. frutescens, Lasteyr.*

Had Dr. Aliotta spoken of *G. brasiliense* (the plant he calls *G. religiosum*) as the chief stock that had hybridised *G. barbadense*, I should have been prepared to concur; but I feel fairly certain *G. hirsutum* has in no way contributed to the formation of Sea Island, though it has doubtless been one of the ancestors with *G. barbadense* in the formation of Allen and other Long Staple Uplands. But I am unable to identify some of the plants named above, and regard others as probably only cultivated states (possibly themselves hybrids), while I view still a few others as most likely quite unconnected with *G. barbadense*. Further, I am disposed to sweep all the undoubted forms of this species, in the above and other such enumerations, that cannot be accepted as *G. barbadense, Linn.*, proper, or *G. vitifolium, Lamk.*, into one variety, as follows:—

Long Staple Uplands.

41. Var. maritima, ***Watt:*** *G. MARITIMUM, Tod., Oss. su Cotone,* 83; *Rel. Cult. dei Cot.,* 1877–78, 225–33, *t.* VII., *and also G. MARITIMUM, VAR. POLYCARPUM, Tod., l.c., t.* VIII.; *G. BARBADENSE, Parl., Sp. dei Cot.,* 1866, 48–54 (*in part*), *t.* III.; *G. MARITIMUM, C. Müll., Walp., Ann. Bot.,* VII., 1868, 413; *Aliotta, Riv. Crit. Gen. Goss.,* 1903, 28–32.

The Sea Island Cottons (proper), also the Gallini Cottons of Egypt.

Description. A glabrous annual with ascending branches which are given off from the very bottom of the stem; leaves very large, broad, deeply 3- to 5-lobed, distinctly cordate, lobes spreading ovate oblong acuminate; fruits 3-celled, elongated, opening freely; seeds free, naked, and floss very long, $1\frac{1}{2}$ to $2\frac{1}{2}$ inches, somewhat creamy coloured, but very fine, strong and silky with comparatively regular twistings. **(See Plates Nos. 46C, 47 and 48.)**

Tropical islands. *Habitat.*—Cultivated in warm insular countries, but never satisfactorily when remote from the sea. The greatest success has been attained in the islands off the coast of Georgia and Carolina, with Charleston as the emporium of the traffic.

Recently the endeavour to organise a cultivation of this special staple in the West Indies would appear to have given every satisfaction, and already indications have been obtained of its having become an established commodity. In commerce mention is frequently made of Sea Island cotton from Hawaii, Fiji, the Malay States, Queensland, and Egypt. I have not, unfortunately, had the opportunity of examining authentic botanical specimens of the plants actually grown in some of these countries, but what I have seen induces me to suppose that the Sea Island referred to may be (as I know it is in Egypt) either degenerated stocks or special races of *G. barbadense* or *G. vitifolium*, but not the true Sea Island Cotton of the islands of Georgia and Carolina.

Degenerated states.

Cultivation

Climatic conditions. *Acclimatisation.*—Dr. Evans says: 'It may be cultivated in any region adapted to the olive and near the sea, the principal requisite being a hot and humid atmosphere, but the results of acclimatisation indicate that the humid atmosphere is not entirely necessary if irrigation be employed, as this species is undoubtedly grown extensively in Egypt. As a rule, the quality of the staple increases with

the proximity to the sea, but there are exceptions to this rule, since that grown on Jamaica and some other islands is of a rather low grade, while the best fibre is produced along the shores of Georgia and Carolina.'

Egyptian cottons.

The uncertainty regarding the climatic requirements of this plant disappears if the view be accepted that in modern commerce several widely distinct stocks are all returned, but wrongly so, as being Sea Island cottons. The bulk of the so-called Sea Island cotton of Egypt, for example, to which Dr. Evans refers as being successfully grown under an atmosphere by no means humid, but with liberal soil moisture (irrigation), is botanically a series of races or hybrids of *G. peruvianum*, and embraces only rarely forms of *G. barbadense, var. maritima*. *G. peruvianum* is, in fact, a plant that frequents regions with fairly dry (non-insular) climates, which are thus more akin to that of Egypt than to the conditions that prevail along the shores of Georgia and Carolina or in the West Indies. Attention to this subject would thus seem of vital importance in order to safeguard needlessly disappointing experiments being undertaken.

Introduction into America.

It may be useful to transcribe here a passage from Donnell ('Hist. Cotton,' 1872, p. 48), even although already partly alluded to, since it gives one version of the story of the introduction of this cotton into America. The origin of the Sea Island cotton is thus related by one Patrick Walsh, in a letter to Dr. Meares: 'I had settled in Kingston, Jamaica, some years ago, when, finding my friend, Frank Leavet, with his family and all his negroes, in a distressed situation, he applied to me for advice as to what steps he should take, having no employment for his slaves. I advised him to go to Georgia and settle on some of the islands, and plant provisions until something better turned up. I sent him a large quantity of various seeds of Jamaica; and Mr. Moss and Colonel Brown requested me to get some of the Pernambuco cotton seed, of which I sent him three large sacks, of which he made no use but by accident. In a letter to me during the year 1789 he said: "Being in want of the sacks for gathering in my provisions I shook their contents on the dung-hill, and it happened to be a very wet season; in the spring multitudes of plants covered the place. These I drew out and transplanted them into two acres of ground, and was highly gratified to find an abundant crop. This encouraged me to plant more. I used all my strength in cleaning and planting, and have succeeded beyond my most sanguine expectations."'

Pernambuco seed.

1 2 3 4 5 6

No. 48. GOSSYPIUM BARBADENSE, *LINN.*
VAR. MARITIMA, *WATT* (SEA ISLAND COTTON.)

Photographic reproduction (half life size) of a coloured drawing designed to manifest the characteristic features of the plant of modern commerce.

(*a*) Three celled fruit : (*b*) naked black seed with its 2 inch long floss : (*c*) bud showing form of calyx and internal glands alternating with the bracteoles.

It would be unsafe to suppose that is the only story of the introduction of Sea Island cotton (or perhaps rather, to affirm that this was the original stock from which in time that cotton was evolved), but it is highly instructive, so far as it goes. The seeds came from Pernambuco, and there is little or nothing in the story to justify the belief that the plant had been first acclimatised in Jamaica. Moreover, what particular plant had been procured from Pernambuco we have no means of judging, but the Brazilian origin is strongly suggestive of *G. brasiliense*—a species which from other circumstances I am disposed to regard as closely connected with the history of *G. barbadense, var. maritima.*

By way of illustrating the commonly accepted view it may be mentioned that the 'A. B. C. of Cotton Planting'—a booklet issued by the Imperial Department of Agriculture in the West Indies (No. 31 of 1904)—asks the question: What is Sea Island cotton? and answers it as a cotton originally obtained from the West Indies, but improved by cultivation in America. As illustrative of the hazy impressions occasionally accepted as satisfactory, the following may be cited:—Spix and Martius ('Travels, &c.') say: 'The Sea Island was introduced from the Bahamas, or more remotely from Anguilla—one of the West India Islands. The New Orleans does not differ specifically from the Sea Island cotton, and is admitted by the planters of the South to be identical with the plant of Mexico, whence they procure their finest seeds. It is conjectured that it was from the neighbouring coast of Mexico that the indigenous cotton of that country was introduced into the West Indies, and thence taken to the Island of Bourbon. Hence we may account for *G. barbadense* being identical in species with the New Orleans and Sea Island as well as with the Bourbon Cotton.'

Hazy impressions

Mr. Lyster H. Dewey, in a communication (dated August 23, 1906) that accompanied the admirable set of botanical samples of the cottons grown in the United States of America, sent for my inspection, observes: 'The Sea Island type mentioned in my former letter is cultivated on James and Edisto Islands and the adjacent mainland of the coast of South Carolina, and to a slight extent along the coast of North Carolina as far north as Elizabeth City, and across the interior of Southern Georgia and Northern Florida. Very little cotton is cultivated in the coast region of Georgia and Florida, and none at all in the latter State, except in the northern countries, where the conditions are exactly the same as those in Southern Georgia.

Actual area.

The cultivation of Sea Island cotton that was formerly carried on to a slight extent in Louisiana and Texas has been discontinued in that region. All of this Sea Island cotton is of one distinct type, without any marked varieties and but slight variation. The leaves are all rather deeply 3-lobed, with a long central lobe. The bolls are rather long-pointed and almost universally 3-locked, that is 3-celled. The seeds are usually naked. This species crosses readily with American Upland cotton, and in many instances the results of the cross show in fuzzy seeds. The cultivation of Sea Island cotton has recently been taken up on a commercial scale in the British West Indies, and also in Cuba and Porto Rico, the seed having been secured chiefly in South Carolina.' (Cf. with the observations made under *G. hirsutum*, p. 194–5.)

Crossed with fuzzy cotton.

Foaden (*l.c.*), speaking of the true Sea Island cotton, observes that 'It is grown in America on a few small sandy islands off the coast of South Carolina and Georgia, and on the lowlands near the sea in these States as well as in Florida. It cannot be successfully raised inland, as the quality greatly deteriorates.' 'The origin of the plant is somewhat doubtful, and when first introduced into America it was entirely different to its present form.' With this last opinion I most completely concur. Many writers, for example, say that when first introduced into America the Sea Island cotton was a perennial, and that owing to the shortness of the summer in South Carolina and Georgia it rarely matured fruit. Through the accident of a mild winter and the selection of early maturing pods, when combined with more advantageous methods of cultivation, a stock had been gradually matured with an annual habit directly adapted to the climatic conditions of a limited tract of country in the United States. This new and very special stock embraces all the finest grades and the most valuable cottons of the world, and is in fact the true Sea Island.

Changed from perennial to annual.

One of the earliest descriptions of the area of Sea Island cotton of the modern traffic of the United States, would appear to be that given in a little book ('Travels to the Alleghany Mountains through Ohio, Kentucky and Tenessee back to Charleston in 1802') written by F. A. Michaux and published in 1805, in which definite mention is made of Sea Island cotton, and this is perhaps the first authentic and detailed account of it. He says: 'In winter the markets of Charleston are well stocked with live sea-fish, which are brought from the northern part of the United States in vessels so constructed as to keep them in a continual supply of water. The ships engaged in this kind of

Early account.

traffic load, in return, with rice and cottons, the greater part of which is re-exported into Europe, the freight being always higher in the northern than in the southern States.'

Rice displaced by cotton.

'The culture of rice,' he says, 'in the southern and maritime part of the United States has greatly diminished within these few years; it has been in a great measure replaced by that of cotton, which affords greater profit to the planters, since they compute a good cotton harvest equivalent to two of rice. The result is that many rice fields have been transformed into those of cotton, avoiding as much as possible the water penetrating.

'The soil most adapted for the culture of cotton is in the isles situate upon the coast. Those which belong to the State of Georgia produce the best of cotton, which is known in the French trade by the name of "Georgia Cotton," "fine wool," and in England by that of "Sea Island Cotton." The seed of this kind of cotton is of a deep black, and the wool fine and very long. In February 1803 it was sold at Charleston at 1*s.* 8*d.* per pound, whilst that which grows in the upper country is not worth above seventeen or eighteen pence. The first is exported to England, and the other goes to France; but what is very remarkable is, that whenever by any circumstance they import these two qualities into our ports, they only admit of a difference of from twelve to fifteen per cent. The cotton planters have particularly to dread the frosts that set in very early, and that frequently do great damage to the crops by freezing one half of the stalks, so that the cotton has not an opportunity to ripen.' The traffic at the time of which Michaux wrote was apparently, however, not very extensive, and the cotton was not then shipped direct.

Price in 1803.

Charleston.

The chief market for Sea Island cotton is still, however, Charleston. The demand for extended production would seem to hinge on three considerations:—Whether the West Indies, Egypt, India, &c., are ever likely to be able to grow an appreciable amount of this very remarkable cotton, the plant being acclimatised in these new homes without loss of its valued properties. Whether or not by careful selection special stocks can be evolved from it, in direct adaptation to altered environment, that would still prove worthy of cultivation. Lastly whether, assuming the botanical explanation here suggested to be correct, it might not be possible to produce from the original stocks (*G. vitifolium* or *G. barbadense* × *G. brasiliense*) new races in direct adaptation to the climatic and soil condition of each country, that would serve the purpose aimed at more effectually than

New Forms.

Acclimatisation.

by efforts at acclimatisation of the existing stock. Certainly this much is in favour of fresh and independent endeavours being made, in each and every country—namely, that the attempts at acclimatisation have not hitherto been satisfactory. Even in the West Indies, where the greatest success has been attained, the results have been by no means uniform : in Barbados and one or two other islands quite as good cotton as that of the Sea Islands of America has been produced, while Jamaica is still reputed to afford a much inferior cotton. So also Egypt, though it does not produce the true Sea Island cotton to any material extent, has by a happy accident found in *G. peruvianum* its natural and highly satisfactory long staple. In 1864 Spruce found that Sea Island cotton could not be profitably grown in Peru. (Cf. Spruce, 'Cult. of the Cotton in N. Peru,' p. 69.)

Expert studies.

Principal George F. Foaden, of the School of Agriculture in Egypt, paid a visit (May 1903) to the United States, and published a most valuable report of his studies of long staple cotton which will be found in the 'Journal of the Khedivial Agricultural Society' (vol. v., pp. 133–78), and in 'Bulletin No. 62 of the Bureau of Plant Industry of the U.S. of America,' issued in 1904. A few months later Sir Daniel Morris and Mr. J. R. Bovell contributed a detailed report of their experiences and conclusions regarding 'Sea Island Cotton,' to the 'West Indian Bulletin' (vol. iv., pp. 287–374). This

Practical experiments.

was the outcome of an official visit paid (September and October 1903) to the Southern United States in order to study the conditions under which Sea Island cotton is there grown. Mr. W. A. Orton, an officer of the Department of Agriculture in the States, was deputed to accompany Sir Daniel and his coadjutor 'to South Carolina and Georgia to explain the various experiments carried on with a view of improving the yield, length and strength of the fibre, resistance to disease, and adaptation to soil and climatic conditions of the Sea Island cotton.' From these two reports we have observations that cover the whole period of the cultivation of the plant and the manipulation of the crop, made by experts well qualified to contrast the systems pursued in the States with their own personal knowledge in other countries.

Since it is hardly possible in this work to attempt to do more than indicate the chief sources of information, regarding the various species of *Gossypium*, the reader desirous of recent details of Sea Island cotton can hardly do better than procure these reports of personal study.

Varieties and Races.—The Sea Island plant may accordingly be spoken of as embracing all the higher grade cottons of *G. barbadense*, the lower grades being the more typical conditions (botanically) of the species. The isolation of *G. vitifolium* I regard as a matter of convenience, commercially and historically, but of the greatest possible uncertainty botanically. In fact it seems highly probable that the plant recognised by me as *G. vitifolium* may have been the original stock, and *G. barbadense, Linn.* (more especially *G. maritimum, Tod.*), the perfected and final development as a cultivated plant. The hesitation of the early botanists to admit *G. barbadense* and the ambiguity that prevailed (and still prevails) regarding it, seems at all events to favour this view. What originated the higher grade Sea Island cottons I am unable to say for certain, but would not be at all surprised, as already suggested, were they proved by actual experiment to be hybrids of *G. barbadense* (or *G. vitifolium*) × *G. brasiliense* in time improved and perfected by selection. The best stock was apparently produced comparatively quite recently (and perhaps unintentionally) in the moist insular and tropical climate of the West Indies or of the American Sea Islands.

Races.

Ambiguity.

Hybrid.

I much regret that the material at my disposal does not admit of my attempting a classification and description of the various forms of the Sea Island cotton. Most of my correspondents have described the plants grown by them as in no respect differing from the well-known types of the islands of Georgia and Carolina. Indeed, in many cases the admission is made of their stock having been obtained therefrom. A glance at the illustrations furnished by me (**Plates Nos. 46, 47 and 48**) will, however, suffice to show that there is a considerable range in form which, while not so great perhaps as under *G. mexicanum*, is still none the less extensive and valuable.

Classification impossible.

Under *G. mexicanum* mention will be found to have been made (p. 232) to a condition in which lateral shoots are suppressed, thus bringing three or four flowers into an axillary cluster. This has been described as the Cluster and Semi-Cluster cottons, of which Chaco, Welborn and Willet's Red Leaf are perhaps the best known examples. But a clustered condition is by no means confined to the Upland cottons: it occurs also among the Sea Islands. Todaro has figured an example of this nature in his *G. maritimum, var. polycarpum* (cf. 'Relaz. Cult. dei Cot.,' 226, t. VIII.) which thus differs from the corresponding cluster cottons of *G. mexicanum* by being (*a*) glabrous or nearly so, (*b*) by having deeply 5-lobed leaves, (*c*) by the

Cluster cottons.

yellow petals having purple claws, and (*d*) by the seeds being naked instead of possessing a fuzz. The plant thus named *polycarpum* by Todaro has, therefore, to be regarded as one of the more distinctive cultivated races of *var. maritima*. So again the transition into the Long Staple Upland cottons (e.g. Allen, &c., pp. 234–5) from the Sea Islands is often so gradual that the line of separation is sometimes difficult to draw. It has been freely admitted by most writers that the Sea Island cottons readily hybridise with the Uplands, but in every case of this nature hitherto recorded the seeds are stated to have become fuzzy, thus manifesting either the greater dominance of that character or the reappearance of a condition from an ancient stock, brought into prominence through the exhibition of a botanically remote influence. The rapidity with which Sea Island cotton degenerates may also be due to the same circumstance—namely, the ease with which the conditions supervene of the ancestor more directly suited to the new environment.

Hybrids.

Degeneration.

Improvement.

Improvement of Stock.—The care that has been bestowed in the selection and development of the races of this particular form of cotton is illustrative of some of the best systems of cotton improvement generally. It would unfortunately, however, take too much space to give more than one or two examples. Mr. Herbert J. Webber, Physiologist in charge of the Laboratory of Plant Breeding, under the Department of Agriculture in the United States, has devoted much attention to this subject, and his numerous papers that have appeared in the 'Bulletins of the Bureau of Plant Industry' and other publications of the United States of America will richly repay perusal. As illustrative of the methods pursued and the results obtained, mention may be made of the special race known as the Seabrook. This appeared in James Island about 1891, and was subsequently improved by Mr. F. P. Seabrook, after whom it was named. The method of selection employed was that pursued by most growers of Sea Island cotton. Several of the best plants observed in a field are marked and watched during their growth. They are picked separately and registered. The seed cotton of each is weighed, and the proportion of the lint after ginning next carefully recorded. They are then critically tested as to length, fineness, strength, colour, softness, seed-covering and uniformity of staple. The seed from the plant that answers best to all these tests is retained and the others rejected. That seed is next season planted by itself, and usually about 500 plants are obtained from the

Seabrook.

Method of selection.

original one. These are carefully studied and obvious departures from the type uprooted. The seed from the remainder is, during the subsequent season, employed to sow about five acres, and from that stock seed is procured for the general crop in the fourth year. A new plant is chosen and the process of improvement repeated annually. In this way, by continuous selection, the stock is preserved, and many of its peculiarities become more or less fixed.

Registration of properties.

In one of his contributions on this subject, Mr. Webber narrates the system pursued by another experienced planter, Mr. W. A. Clark, of Columbia, S.C., on his James Island plantation. The selected plants are tested according to (*a*) degree of covering of seed, (*b*) size of seed, (*c*) length of staple, (*d*) fineness of staple, and (*e*) uniformity in length. Five grades are recognised under each of the tests (*a*) to (*e*) inclusive, and a first place is valued as five, a second as four, and so on. A table is filled up to represent the produce of the selected plants, and the highest valuation there shown is taken as denoting first quality. The next step is the test of ginning. Two samples that each total, say 16, by the above system, are compared as to the amount of seed-cotton (unginned cotton) required to produce a standard bale of 300 lbs. of ginned cotton. This is obtained by the equation:—weight of lint to combined weight of lint and seed, as 300 lbs., is to x. A cotton that shows a valuation of 16 was found to require 1,001 lbs. unginned to produce 300 lbs. ginned cotton; another that gave a total of only 11 by the combined merit standard necessitated 1,068 lbs. to produce the bale. Obviously, the former would be selected as the best stock. In the early days of the Sea Island cotton the proportion of lint to seed cotton was 1 to 5; by the modern improvements it has been reduced to 1 to 3. In another way the improvement accomplished may be even more forcibly demonstrated. In the days of slavery the individual estates under cotton were large—say 400 to 500 acres—now they are rarely more than 50 to 60 acres. In the former system the yield did not exceed 80 to 100 lbs. to the acre, now 250 to 400 lbs., or even close on 600 lbs. of ginned cotton, is the usual outturn. (See p. 290.)

Proportion of lint to seed-cotton.

Yield per acre.

Immune to Wilt.

The second illustration that need be here given may be taken from the efforts to procure stock immune to the destructive disease known as 'Cotton Wilt.' All other methods of treatment having failed to combat that disease, the endeavour was made to produce a resistant stock. It was observed that even in the worst infected plots a few plants remained healthy. The most satisfactory one of

the healthy plants was marked and its seeds specially preserved. These were next year sown in a badly infected plot of land, rows of the supposed immune stock alternating with ordinary seed. Any plants in the special rows of selected stock that showed disease were at once uprooted and the seed of the best and most healthy plants preserved. In this way the Department of Agriculture, in co-operation with Mr. E. L. Rivers, of James Island, S.C., have produced several distinct races of wilt-resistant plants. In 1902 sufficient seed had been obtained to sow 15 acres with resistant seed. Similar experiments were conducted with 'Upland' in addition to the 'Sea Island,' so that within the past few years great progress has been made in the development of superior grade resistant stocks.

Rivers Sea Island.

Qualifications.

Conditions to be observed in Selection.—It is held that the stems of the most desirable plants should not exceed 4 to 5 feet, and the branches should spring from near the ground and be fairly uniformly distributed throughout. The main branches should carry many laterals, composed of short internodes, in order to secure facility in picking. The bolls should be fairly long in shape and should open completely, so as to discover the cotton free from leaf and other impurities, but the lint should not become suspended, since it might fall to the ground and get blown about in the wind and thus impregnated with dust, dirt and leaf. High winds during the maturing stage are undesirable, and where such prevail the cultivation of this particular cotton may have to be abandoned or guarded against by the special selection of stock with capsules that do not open out to the extent to allow of the separation and drifting of the lint. With moderate winds protection may be afforded by the provision of hedges on the windward side of the field.

High counts.

The Staple.—As grown in the United States, the staple ranges from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in length. It is used for all the higher counts—namely, from 120s up to 450s or more. But it is also the strongest cotton: hence where strength is specially desired, Sea Island cotton is resorted to—as, for example, for sail-cloths, linings of pneumatic tyres, &c., and high-class goods such as gloves, laces, &c. It is thus the most expensive cotton, and that being so quality is not the only consideration—scrupulous cleanliness is quite as essential to success. The greatest care is therefore taken in handling, in ginning with roller gins (not saw-gins), and in light bailing so as to avoid breaking or discolouring the cells. Selection with a view to obtain uniformity of length is another criterion of much importance. Lastly, the lint

Quality and cleanliness.

should be not only long, but fine and silky. It is well known that the yield of floss is less from this than from any other species, and hence must be compensated for by the price realised, but to obtain high prices purity and uniformity are as indispensable as length of staple.

But production is necessarily restricted by climatic and soil conditions, so that wherever this cotton can be satisfactorily grown it should be preferred to all others, and the conditions and qualifications indicated earnestly observed. It is freely admitted, however, that with Sea Island, far more than with any other cotton, it is easier to produce low than high grades, so that a tendency to degenerate is ever present, and can only be guarded against by systematic selection of stock, and doubtless also fresh hybridisation will be found equally effectual. Still the demand for the finer counts increases, and the prices realised continue to keep pace with extended production. On this subject Morris and Bovell ('West Indian Bull.,' vol. IV. p. 291) observe: 'It is improbable that the comparatively limited quantity of Sea Island cotton likely to be produced in the West Indies will seriously affect the market for long-staple cottons. The production of Egyptian cotton is about 500,000 bales, of Sea Island cotton from South Carolina, Georgia, and Florida about 50,000 bales annually. If we assume that in the West Indies, at the end of five years, about 30,000 acres will have been placed under cultivation in Sea Island cotton, the return from this area (at the rate of 300 lbs. of lint per acre) will not exceed 18,000 bales. Taking into account the increased demand that will, in the meantime, have arisen for long-staple cotton, there need be little, if any, apprehension as to the price of Sea Island cotton being maintained at such figures as will prove remunerative to the growers.'

Tendency to degenerate.

Total production of Sea Island.

It has been stated that of all the West Indian Sea Island cottons recently imported into England that from Barbados was the best. Further, Mr. Atkins (Secretary of the British Cotton-Growing Association) says that 'a minimum of 9*d.* a pound, and probably more, can always be relied upon.' Recently the prices for Sea Island have ruled high, as much as 13*d.* for medium, 21*d.* for extra fine grades, while Upland cottons fetch only 6*d.* to 8*d.* a pound.

Barbados supply.

Hybridisation.—The botanical study of this plant, it may be confidently affirmed, necessitates belief in hybridisation as, at least, one of the influences in its racial production. But in further pages (333–5)

Hybridisation.

particulars will be found of an early historic record that points fairly conclusively to the supposition that direct hybridisation has been resorted to in the production of the high grades of West Indian cotton. Once so produced, selection on the lines above indicated may be accepted as sufficient to account for the subsequent elaborations in direct accord with environment and the requirements of trade. Speaking of hybridisation it may be here mentioned that Mr. W. Austin Cannon, in a most instructive paper entitled 'Spermatogenesis of Hybrid Cotton' (see 'Bull. Torrey Bot. Club,' vol. xxx. [1903], pp. 133–72) says that *G. barbadense* was one of the ancestors used by him in his experiments and studies. The possibility of hybridisation having played a distinct, if not an important, part may, therefore, be confidently accepted. (See p. 339.)

American record.

The actual record of the United States may be now recapitulated. About the year 1786 Sea Island cotton was carried to Georgia from the West Indies (cf. p. 20). The hybridisation had thus been accomplished before the arrival of the stock—if the idea of hybridisation be accepted as at all necessary to account for the plant as known to us. If hybridisation be rejected, then the dilemma is presented of where the plant came from, since, in spite of the fact that Linnæus appropriated for it the name *G. barbadense*, there is no evidence of its being an indigenous species in that or any other of the West Indian islands. It is, in fact, a species, the original habitat of which cannot now be traced. The first plants raised in Georgia were injured by the frost in the autumn before they had fruited. Fortunately they came up again from the roots, and succeeded in producing a few ripe fruits before the fall of the ensuing year. These were carefully preserved and the seed from them sown the following year, the result being that in a few years' time the development of an early-flowering annual race (from what apparently was originally a perennial stock) became an accomplished fact, which not only gave to America, but to the world, the finest long-staple annual cottons.

Early-flowering annual.

Pruning cotton.

This historic sketch brings to mind the practice in Guadeloupe, as narrated by Père Labat in 1724, with *G. vitifolium* (one of the ancestors, doubtless, of the Sea Island plant), namely, of cutting down the plants every two or three years. The black-seeded cotton of that island was grown as a perennial, but it was fully recognised that annual, or at most, biennial shoots afforded the finest grade cottons. Labat tells us that the plant so treated produced a much superior cotton to that of the Levant, and this fact, together

with the great reputation of the Surinam and Cayenne cottons at a slightly earlier date, might easily account for the early West Indian colonists having procured seed both from the Southern Islands of the Lesser Antilles and from Guiana. (See p. 20.) Similarly we know they had procured the kidney cotton of Brazil. By the beginning of the eighteenth century the European planters of the West Indies were thus growing these two plants side by side. I assume, purely and simply from a botanical study of the Sea Island plant, that a cross between the two species mentioned may have been naturally accomplished, the progeny being recognised as a new and superior race, hence preserved and in time developed into the Sea Island plant as we now know it. At all events *G. barbadense, var. maritima*, which in some respects is intermediate between *G. vitifolium* and *G. brasiliense* in its characteristics, was not known until subsequent to the dates I have mentioned, and originated in the country where the two types named were, very possibly, first brought into juxtaposition. It is on these grounds mainly that I am led to contemplate hybridisation as a possible stage in the production of this most valuable and highly specialised race of cotton. (See pp. 334, 346.)

Origin.

But there is still another point of considerable importance to be borne in mind. If the original stocks came from Surinam for the one, and Pernambuco for the other ancestor, they came from latitudes that lie, the former north and the latter south, between 5° and 10° of the Equator. The progeny was finally perfected and established far to the north in the Sea Islands of Georgia and South Carolina, viz. between 30° and 33° north latitude, while Barbados, Guadeloupe, &c. (the islands of the West Indies in other words), became the half-way houses, placed as they are between the 15° to 20° of north latitude. But starting from what may be called the promontory of Guiana and passing through the successive chains of the Antilles, the area of cultivation of the plant here discussed passes naturally to the shores of Florida, Georgia and Carolina. Outside that region it has never, so far, been successfully grown, and within even that area there are localities that produce much inferior staples to others.

Distribution.

My studies of the pollen-grains have not been conducted for sufficient time to admit of that repeated confirmation that is essential to justify the formulation of definite opinions. But I may perhaps add that the presence of two kinds of grains in all the examples of Sea Island investigated by me, leads me to regard that circumstance as corroborative of the conception that it is a hybrid stock, the more

Pollen-grains.

so since the two forms of grain seen correspond very closely with those found in the two presumed ancestors. (See p. 346.) Lastly, I have already mentioned the circumstance of the rapidity with which the various races of this stock degenerate under unfavourable environment as in itself suspiciously indicative of hybridisation.

Sea Island in America.

Sandy Loams.

Soils and Climates.—Sea Island cotton is most successfully grown on fine sandy loams. It is hopeless to attempt its cultivation on heavy poor soils. Dry shallow soils, as also water-logged sour soils, must be guarded against, for good drainage is indispensable. A writer in the 'News and Courier,' the leading newspaper of Charleston (of date April 22, 1880—see 'West Ind. Bull.' iv., 1904, pp. 359 *et seq.*), narrates the difficulties the planters of the American islands had to surmount. Even at that time, he tells us, as much as 50 miles of subsoil draining had been accomplished in James Island alone. But light sandy soils give small plants and low yield. On slightly heavier and richer soils the yield is greater and the fibre stronger, but on heavy clay soils the plants become coarse and leafy and the yield of fibre is low. Light and fairly deep soils may be rendered productive by the use of farmyard and other manures. Lastly irrigation with scanty rainfall is advantageous. But on the other hand districts with an annual rainfall of more than 80 inches are unsuited.

Rain at growing season.

Provided there is sufficient rain in the growing season the Sea Island cotton can afterwards bear comparatively dry and hot conditions. It is believed in America that when the full period of vegetative growth has been attained—that is to say, when the plant has stored up within its own tissues all the material necessary for the production of fruit—a diminishing temperature and decreasing moisture, as also an increasing difference between day and night temperatures, are favourable conditions, since these tend to check further growth and induce the production of fruit and fibre.

Temperature.

The following may be taken as representative of the best conditions for this cotton:—the mean temperatures being exemplified by alternate monthly records thus—January 50°, March 56°, May 72°, July—August 80°, Sept. 75°, Nov. 53° and Dec. 47°. The highest maximum is 95°, the mean maximum 68°, the lowest minimum 10°, the mean minimum 49° F.

Rainfall.

The corresponding rainfall for the year is 32·70 inches, indicated by the following selected months:—January 2·25, March 2·40, May 4·30, July 5·53,

Sept. 0·40, Nov. 0·79 and Dec. 1·85 inches. The rainfall is thus highest during the growing season of the cotton, May to August, and lowest when the crop is ripening—namely, September to November. The climate of the American islands is certainly not excessively moist. In fact there are on an average 235 clear days a year. The winter cold is moreover only sufficient to check active agricultural operations from the middle of December to the beginning of February.

High cultivation.

Rotation and Cultivation.—In the districts of the United States (South Carolina, Georgia and Florida, coast tracts and islands) that produce Sea Island cotton the rotation usually pursued is (1st) year cotton, (2nd) year fallow, (3rd) cotton and (4th) a leguminous crop. It is freely recognised that, with this particular cotton, high cultivation is essential. In James Island, where subsoil draining has been perfected, the old plants are broken down by a roller early in February. Farm-yard manure is thrown into the old trenches and often, at the same time, a quantity of chemical fertilisers given. The land is thereafter thoroughly forked, ploughed, and the heavy clods broken. Ridges are then formed 5 feet apart, and the seeds planted on the top 18 to 20 inches apart. On light soils the plants may be nearer, say 3 by $1\frac{1}{2}$ feet, and the seeds should then be deposited 3 inches below the surface, while in heavy soils they need not be more than 2 inches deep. The season of planting depends on the date of summer rains, and accordingly varies greatly. But if at all possible early planting is preferable—say in May, June or July. The plants get in consequence strong before being attacked by disease, but on the other hand late planting, say in September, often results in the plants escaping the cotton worm. Sir Daniel Morris observes that the best distance apart is 4 feet by 1 foot, he then adds that in the States the sowings are made in spring and the plants mature in 120 to 157 days, reaping being in July, August, or September. Of the West Indies, however, he remarks that the best season for sowing is in July to August or even into September ('Bull.' *l.c.*, p. 351). In the States the seeds are planted by three workers—one opens the holes, the second drops in a few seeds, and the third carefully covers them over. As soon as the plants appear weeds are hoed up, and when four weeks old a second weeding is given and some of the superfluous plants pulled out from the clumps of seedlings that have appeared. And this thinning is continued at each subsequent weeding until when the plants are six inches high only one stands at each position. When the plants

Distance apart.

Weeding.

are about six weeks old a plough is run between the rows and, by means of the hoe, the loose soil is subsequently drawn up around the stems. In this way the plants are supported against the risk of storms, but where liable to heavy winds it is customary to plant hedges of pigeon-pea or guinea-corn. From time of sowing, in about seventy days the flowers appear, the plants are then four to five feet in height, and are about mid-season, since in seventy days more the harvest may be complete.

Harvest.

The picking is done with great care, and the utmost cleanliness observed. In the Sea Islands it is customary to speak of the crop on the standard of the average number of bolls to the plant. With plants standing 5 feet by 20 inches, every 15 bolls would give 100 lb. per acre, and as already stated, a bale of 300 lb. lint would be obtained from 1,100 lb. In some races of the plant with large seeds the yield may only be 300 lb. lint to 1,500 lb. seed cotton. Hence it follows that the crop may range from 250 to 600 lb. of ginned cotton to the acre (see p. 283).

Yield.

Sea Island in the West Indies.—It seems necessary to repeat here that most of the early botanists, subsequent to Linnæus, have expressed doubt as to their being able to recognise this plant. Macfadyen ('Fl. Jam.' 1837) follows the customary treatment of repeating the Linnean description. He does not use the name Sea Island, but says definitely that he had not met with it on the island. This is practically the position of all the botanical writers who have described the plants of the West Indies until within the past fifty years or so. In none of the historic herbaria, seen by me, are there any specimens of undoubted *G. barbadense, var. maritima*, from the West Indies or in fact from anywhere else. There is certainly no specimen of it in the Sloane Herbarium, if we exclude the type of *G. barbadense, Linn.*—a specimen that originally belonged to Plukenet but of which we know next to nothing as to its origin, and in any case it is hardly Sea Island cotton. As already frequently observed, therefore, Sea Island cotton would seem to be a modern cultivated condition.

Recent knowledge.

A modern plant.

Morris and Bovell ('Sea Island Cotton in the West Indies,' Bull. IV., 1904, No. 4) conclude their most instructive report on the cotton-growing of South Carolina, Georgia, and Florida by the following paragraphs:—'After a careful review of all the circumstances as existing in the Sea Island cotton districts of South Carolina and the West Indies, we are of opinion that, taking into

consideration the difficulties arising from the unreliable character of the labour and the higher rate of wages paid in the United States as compared with the West Indies, the latter should be in a more favourable position for carrying on a successful cotton industry, provided that a suitable selection is made of the localities for cotton-growing, and the planters become fully acquainted with the conditions necessary for success.' Recommended to West Indian planters.

'It has been shown that the quality of the cotton produced in the West Indies is quite as good as the better sorts grown in South Carolina, and it is believed that it may be possible, by adopting skilful and economical methods of cultivation, and introducing labour-saving appliances in the ginneries, for cotton from the West Indies to be delivered at Liverpool at probably less cost than from any part of the Sea Island districts of South Carolina.'

These views were more than confirmed by the results communicated by Sir Daniel Morris in his address to the West India Committee on July 19, 1906, and subsequently on August 29, to the British Cotton-Growing Association at Manchester. Sir Daniel narrated the circumstance of his having personally secured in the Sea Islands a supply of the very best Sea Island cotton seed and conveyed that to the West Indies. On the occasion of the last mentioned lecture Mr. J. R. Barlow asked whether there was any hope of the West Indies producing other types of cotton than the Sea Island. Sir Daniel replied that they were fully alive to the necessity of not producing too much of the finest class of cotton, and were carrying out experiments with the object of getting more body and substance into it. More recently Mr. J. Arthur Hutton, Vice-President of the Council of the British Cotton-Growing Association, addressing a meeting on January 18, 1907, of planters and others assembled at Barbados, said that during the past three or four years about 15,000 bales of Sea Island cotton had been produced in the West Indies, and but for that fact many Lancashire mills would be idle at the present moment. Sir Daniel Morris, at a previous meeting also held at Barbados, warned the planters not to be carried away by the high prices ruling at present. Cotton from Barbados, he added, had fetched 28*d.* a pound, but less than half would still leave the cotton-growers a profit. Messrs. Wolstenholme and Holland (Jan. 7, 1907) observe that West Indian Sea Island has been in good demand and prices have been firm. All arrivals had been freely taken at advancing rates. Medium fine is quoted in Liverpool at

Confirmed.

Seed supplied.

Production in West Indies.

West Indian quotations.

6·85*d.* per lb; West Indian Sea Island good medium 18½*d.* per lb; medium fine 19½*d.* per lb; fine 21*d.* per lb. Prices paid 4*d.* to 24*d.*

A definite position.

These indications of the present position of cotton-growing in the West Indies when contrasted with the fact exhibited above, viz. that so recently as 1904 Sir Daniel Morris and Mr. Bovell were only advocating the desirability of strenuous efforts being made to organise a systematic attempt at Sea Island cotton cultivation in these islands. Moreover when it is recollected that the world's supply of this particular staple has not hitherto much exceeded 50,000 bales, it will be seen that the West Indies have assumed a distinct and definite position in the traffic. Mr. E. Lomas Oliver, commenting on Sir. Daniel's lecture, observed that while the value of the cotton sent from the West Indies in 1906 came only to £63,000, he would like to add that the amount of money thus paid for the cotton was only a small portion of the finished article. That £63,000 worth of raw cotton, without any exaggeration, must have amounted to the payment of at least a quarter of a million in wages in this country. It was no small thing to say that out of the total supply of 14,000 bags of Sea Island cotton, in the short space of four years, 4,000 were now coming from British dominions. It was an enormous stride to have taken.

Wages Paid.

Sea Island in Egypt.—In the account given above regarding Egyptian cottons (under *G. peruvianum*, pp. 219, 222–3) mention is made of the efforts put forth to acclimatise this plant in Egypt. The true Sea Island stock seems to have rapidly degenerated, and moreover, even with continuous importations of fresh seed it was found unprofitable. But as a result of these endeavours certain special races of Egyptian cottons came into existence that undoubtedly possess a strain of *G. barbadense, var. maritima*, or in some cases what might rather be called *G. vitifolium*. These are often spoken of as the long-staple Egyptians, such as the *gallini, jannovitch*, &c.

Unprofitable in Egypt.

Gallini.

Mr. W. Lawrence Balls, of the Khedivial Agricultural Society, Cairo, has recently furnished me with a specimen of a long-staple Egyptian cotton, n. 89*b*, which he speaks of as having flowers lemon yellow with small purple spots and a very long staple. It is known as *charara*. This I identify as a special race of *G. barbadense* coming near to *var. maritima*. It has been crossed, so Mr. Balls informs me, with the *moqui* cotton, n. 209–3, the result being the production of an early-maturity long-staple cotton. This cross is thus extremely interesting, since it is between what is called a naked-seeded plant

Charara.

(*G. barbadense*) and a fuzzy-seeded plant (*G. punctatum*). Such a cross has often been pronounced impossible, but it not only can be, but has been produced, and the seeds are mostly fuzzy, while the resulting stock seems to gradually tend toward the condition known as *G. peruvianum*. (Cf. Long Staple Uplands, pp. 194, 234–5.) Hybrid.

Sea Island in Africa.—Mention is made of experimental cultivation of this cotton in both East and West Africa. It is not possible to discover, however, whether the true Sea Island plant is meant or only the Egyptian, which by many writers is erroneously regarded as being true Sea Island. Wiesner ('Die Rohstoffe des Pflanzenreiches,' 1903, vol. II. p. 257) very rightly observes that the better class African cottons practically mean Egyptian stocks.

East Africa: Moçambique cultivation.

Col. Alfred J. Arnold (Inspec. Gnal. de Explor. Companhia de Moçambique) speaking of the experience gained with the cultivation of cotton, in the provinces of Manica and Sofala, says that the experiments made 'tended to prove that Egyptian or Sea Island plant, producing the long-fibre cotton of the more expensive class, was better adapted to the soil and climate than American Upland cotton of a shorter staple. To this class of cotton, therefore, the attention of the Companhia and the public has been specially directed, and so far with undoubted success' ('Memo.' &c., 1906, p. 48). But the samples of long-staple cotton seen by me from East Africa have been mainly Egyptian *mit afifi*, more rarely *abassi*, none of Sea Island proper, and indeed I much question the true Sea Island being anywhere successfully grown and its properties preserved in Africa or Egypt. But Sadebeck ('Kulturgew. der deut. Kolon.' p. 304) strongly urges not to attempt the cultivation of any other cotton except Sea Island. If confined to New Guinea and the Bismarck Archipelago that recommendation might be worthy of being tested definitely and finally, but if given to the planters of Togo-land it has quite another meaning. At all events the true Sea Island has seldom been successfully grown in any locality more than 30 miles distant from the sea, and there is nothing to show that the recent successes with cotton cultivation in West Africa is in any way connected with the production of Sea Island cotton. (Cf. with remarks under *G. punctatum*, pp. 174–81).

West Africa: Togo-land.

Baron ('Flora Mad.' in Journ. Linn. Soc. xxv., 1890, pp. 246–94) speaks of *G. barbadense* as introduced into Madagascar, but gives no particulars as to the race grown, extent of cultivation, or success attained.

Sea Island in India.—Some forty years or so ago vigorous efforts were made to cultivate this plant in India, and as a rule complete failure was the only result. Wight tells us that he succeeded to some extent in South India, but only when grown under the sea breezes.

The subject of the acclimatisation of Sea Island in India was soon forgotten, though spasmodically revived here and there by new adventurers. In the Andaman Islands it is possible, however, that success may be attained so far as climate and soil are concerned, but the labour question is serious and the limited area available almost prohibitive. Still, the annual reports of the administration of these islands since 1862 onwards contain repeated reference to the endeavours that have been made to acclimatise this cotton.

Andaman Islands.

Sea Island in Hawaii, Fiji, Malay States and Queensland.—Many writers have discussed the prospects of these and other countries as hopeful sources of Sea Island cotton. For some time Fiji seems to have grown that plant successfully, but only so long as difficulties in America kept the price at a high level. In consequence it is not unusual to read of exports of Sea Island cotton from Fiji. The experiments conducted in Hawaii appear to have given the greatest possible encouragement, but in Queensland, while the plant could be grown, the labour question appears to have proved disastrous. (See 'Hawaiian Forester and Agriculturist,' vol. I., 1904.) Speaking of the Malay, Mr. A. S. Baxendale ('Bull. Straits and Fed. Mal. States,' vol. II. 1903, pp. 345–9) discusses the cottons there grown, the chief apparently being a plant called by the Javanese *kala-kala*, which is supposed by Mr. Baxendale to be *G. herbaceum*, but is much more likely to be *G. Nanking*. The *kapas banda*, on the other hand, is thought to be Sea Island cotton, but Baxendale does not view it with as much favour as the indigenous *kala-kala*. So also Dr. K. W. Tromp de Haas wrote a 'Review of the Introduction of the Cotton Industry into the Netherlands India.' This was translated ('Bull.' *l.c.* III., pp. 195–232) by Mr. W. Seelhorst from 'Teysmannia,' and in that paper mention is made of *G. barbadense* and *G. peruvianum*, but from the latter being spoken of as having the seeds connected with each other, *G. brasiliense* was doubtless meant. The former is said to afford the Sea Island staple, the best of all cottons. But a large portion of Teysmann's 'Manual of Cotton-Growing in the Netherlands' consists in reviewing the conditions and results in America and Egypt. Very little can be viewed as narrating the experience and knowledge attained in Java. Subsequent to Teys-

Fiji.

Hawaii.

Malay.

Java.

mann's time many writers have urged the advantages of cotton-growing in general and of Sea Island in particular, but it cannot be said that much progress has been made, except that the conviction seems to have gained in strength that the best results are likely to be attained with the indigenous in preference to the foreign stocks.

42. **G. BRASILIENSE**, *Macf.*, *Fl. Jam.* (1837), vol. I. *p.* 72; *Ameniiou and Bombasin of John Lerius*, *Hist. Brazil* (1557) *apud Purchas*, IV., 1333; *Aminiiù, Marcgraf, Hist. Pl. Bras.* (*apud Pisonem* 1648), 59; *Piso, Nat. Hist. utriusque Ind.* 1658, 186 *except plate, which is G. arboreum; Bambagia arborea di Pernambuco, Zanoni, Istoria Bot.* (1675), 40–44, *t.* 16; G. FRUTESCENS ANNUUM, *&c., Plukenet, Alm. Bot.* (1696), 172, *also Phyt. t.* 188, *f.* 2 (*this plate was originally cited by Linn., Sp. Pl., 1st ed.*, I. 511, *as an illustration of Bombax religiosum, hence possibly G. religiosum of some authors*); G. BRASILIANUM, *Sloane, Pl. Ins. Jam.* (1696), 156–60 (*in part*); G. HERBA FLORE CAMPANULATO, *Morison, Pl. Hist. Univers., Oxon.*, 1699, 517; G. FRUTESCENS ANNUUM, *&c., Philip Miller, Gard. Dict. 1st ed.* (1731), *n.* 3; G. CAULE DECUMBENTE, *Linn., Hort. Cliff* (1737), 350 (*in part*); G. RELIGIOSUM, *Lamk.*, (*non Linn.*) *Encycl. Supp.* (1786), 135 (*in part*); *Cav., Diss.*, 313 (*in part Linn.*); *Kidney Cotton, Edwards, Hist. Br. Col.* (*Jamaica*) 1793, II., 268–71 (*species* V.); G. RELIGIOSUM, *Swartz*, (*non Linn.*), *Kongl. Vetcn. Akad. Handl.* (1790), XI., 24; *Willd., Linn., Sp. Pl. 4th ed.*, 1800, 805 (*non Linn.*); *Guiana and Brazilian Cottons, Rohr, Obser. sur la Cult. du Coton*, 1807, 31–37; *Kidney Cotton, Koster, Travels in Brazil*, 1816, 365–9; G. LAPIDEUM, *Tussac, Fl. Antl.* (1818), II., 67; G. ARBOREUM, *Vellozo*, (*Arrab.*), *Fl. Flum.* VII., (1827) *t.* 49 (*leaves represented as serrated*); G. ACUMINATUM, *Roxb., Hort., Beng.* (1814) 51, *also Fl. Ind.* III., (1832), 186 *and MS. drawing n.* 1,598 (*wrongly named G. vitifolium, see reproduction here given*, **Plate No. 50**); G. ACUMINATUM, *Wight, Ill. Ind. Bot.* I. (1840) *t.* 27, 57–64; *Rinon or Kidney Cotton, Spruce, Cult. in N. Peru*, 69; G. PERUVIANUM, *Royle, Cotton in India* (*in part*), 149–50 *and plate*; G. IMBRICATUM, *Vaupell, Cot. of Gujarat*; G. RELIGIOSUM, *Parl.*, (*non Linn.*), *Sp. dei Cot.* 1866, 54 *t.* 4 (*admirable picture but excl. all synn.*); G. PERUVIANUM, *Seem.*, (*non Cav.*), *Fl. Vit.* (1865), 21–22; G. BRASILIENSE, *Macf., Tod. Relaz. Cult. Cot.*, 265–67, *t.* IX., *and* G. RACEMOSUM, *Tod.* (*non Poir.*) *l.c. t.* XII., *f.* 35; G. RELIGIOSUM, *Schumann*

(*non Linn.*) *in Mart., Fl. Bras.* XII., *pt.* III., 583–4 (*in part*); *J. C. Branner, Cotton in the Empire of Brazil* (*see U.S. Dept. Agri. Bull. Misc. n.* 8), 1885; *G. RELIGIOSUM, Heuzé, Le Pl. Indust.*, 1893, I., 144; *G. peruvianum, Engler* (*in part Cav.*) *Die Pflanz. Ost. Af., &c.*, 1895, *p.* 385; *G. ACUMINATUM, Welwitsch, Cat. Af. Pl. pt.* 1. (*by Hiern*), 1896, 79; *G. CONGLOMERATUM, Wiesner, Die Rohstoffe des Pflanz.* 1903, II., 236; *G. RELIGIOSUM, Aliotta, Riv. Crit. Gen. Goss.* (1903), 44–7 (*in part*); *Kidney Cotton, O. F. Cook, Weevil-Resisting Adaptations of the Cotton Plant* (*in U.S. Dept. Agri. Bull. No.* 88, 1906, 66–7).

Trade names.

Chain, Kidney, Stone, Brazilian, Guiana, Essequibo, Berbiche, Bahia, Pernambuco, and Coton-pierre Cottons. It is also the Costa Rica, Ava, and Siam Cottons of certain writers.

Ancient names.

John Lerius, a Frenchman who lived in Brazil in 1557–8 and wrote a history of that country, tells us of the Bombasin cotton shrubs, with seeds 'close joined and verie much pressed together after the form of a man's kidnie' and which was known to the Barbarians by the name of *ameniiou*. Gabriel Soares de Souza (1570–87) speaks of Brazilian cotton as known to the Natives by the name *maniim*; Varnhagem calls it *manyú*; Claude d'Abbeville, a French missionary in Maranhao (1612–1614), gives it the name *amonyiom*; Marcgraf (1648) calls the plant he collected by the vernacular name of *aminiiu*. The Bugres of S. Brazil have the name *yxomtom*; the Caynas *amany-ri*; the Tupis *amaniú* and *amaniji*; in the Amazonas *Bruun-à*; in the Upper Amazonas *amanihú* and by the Ticuna tribe *tech*. Branner, who wrote a special report on the cotton cultivation of the Empire of Brazil, mentions most of the above names, but adds from his personal knowledge the fact that there are two indigenous and one exotic cotton in Brazil. These are distinguished as *crioulo* (kidney cotton, *G. brasiliense*), *quebradinho* (with free black seeds ? *G. vitifolium*) and the exotic *riqueza* (=wealth-giving) with green fuzzy seeds (? *G. hirsutum* or *G. peruvianum*). A specimen collected by Miers in Central America bears the name *quebradinho* and is *G. brasiliense*. Sir Walter Elliot calls *G. brasiliense* the *paidi* (gold) *patti* or *pamidi patti* (=the wealth-giving) of South India, and Mason says it is the *wa-ku-la*, but according to Burkill it is *themban-wa* (ship cotton) of Burma. It is the 'Ava cotton,' 'Siam cotton,' &c., but is not the true Siam cotton, though it is doubtless both the Guiana and the Brazilian cottons of Rohr.

No. 49. GOSSYPIUM BRASILIENSE, *MACF.*

(A) Specimen in Linn. Herb. to which he made no mention in any of his works, but in his own handwriting named it '*Gossypium Surin.*' ? Surinam; (B) specimen in Sloane Herb. B. M. (Pluk.) Vol. 96, f. 60; (C) Pluk. Alm. Bot. Phyt. t. 188, f. 2—Plate made from B.

Description.

A sub-arboreous bush with very large palmate acuminate 5-lobed leaves that usually dry in herbaria into a dark brown colour; flowers and bracteoles large, the latter often maculated within, and glands on the apex of the pedicels very prominent; capsule elongated acuminate; seeds large, naked or nearly so, striated, conglomerated into a kidney-like mass within each cell. Broad-leaved plants with naked free seeds (much as in some of the states of *G. barbadense*), may often, therefore, with difficulty be separated from *G. brasiliense*, but the converse condition I am disposed to regard as unknown, namely naked kidney seeds found in plants dissimilar from *G. brasiliense* in leaf, flower and fruit. I accordingly regard the combination of characters mentioned as of specific value. **(See Plates Nos. 49 and 50.)**

It may now be useful to furnish a more detailed description than the above diagnostic note:—A shrub 4 to 5 feet in height, but sometimes becomes a small tree. *Stems* and twigs round below, often sharply angled above; purple, glabrous, but roughened by gland-dots. *Leaves* broad ovate, deeply cordate, often central lobe from base to apex 8 inches, and laterals across from tip to tip 10 inches; 5- (more rarely 3-) palmately lobed; the lobes ovate and oblong to deltoid, acuminate, spreading; the central one from 4 to 8 inches long and 2 to 3 inches broad; sinus narrow and thrown up in a fold, almost quite glabrous, except on the veins below and on the very young leaves, which are sometimes stellately hairy; *glands* of the veins irregular, usually only one present, but sometimes two to three, or entirely absent; veins punctated through the prominence of gland-dots; *stipules* long, linear-lanceolate, acuminate, those of the flowering shoots often broad, oblique, and almost auricled. *Inflorescence* axillary shoots one- to five-flowered, placed as a rule on the extremities of the main branches only; *peduncles* angled or striated, negro-papillose coloured on one side; *bracteoles* large, ovate, sub-acute, deeply gashed, the middle tooth often much larger and longer than the others, cordate, auricled very slightly, united below, blotched or variegated on the inner surface; *glands* black, large, placed on the apex of the peduncle and within the auricles of the bracteoles. *Flowers* very large, thin, minutely gland-dotted; *corolla* often twice the length of the bracteoles, minutely puberulous externally, pale yellow with orange or scarlet rarely purple spots on the claws of the petals, colour changing as the flowers age to a pale rose-pink; *calyx* large, cup-shaped, truncate, or irregularly 4- to 5-toothed, many-veined, glabrous. *Fruit* oblong, acuminate, beaked, pulpy in texture, when ripe embraced by the immense accrescent calyx and bracteoles, 3-celled, dehiscing for little more than half its length, valves erect, the margins and beak rigidly reflexed, the partition thus forming in the middle a prominent curved ridge, to which the kidney masses of seeds and wool are adpressed. *Seeds* large, well-formed, bellied, brown-black, striated with darker coloured lines, naked except a tuft of rusty fuzz near the beak, most often quite smooth or marked by twisted ridges or even corrugated on the surface, at times angled or twisted, in consequence of the severity

of the conglomeration. *Wool* abundant, usually very fine, silky, and of a milky-white, but the yield to acre seems poor. The individual cells (of cotton) in this species are straighter and less frequently spirally twisted than is the case with almost any other species. They much resemble, in their natural state, cotton that has been subjected to chemical treatment, such as mercerising. Moreover, the wool is more immediately and completely influenced by treatment with cuoxam than appears to be the case with the staple of any other species (see pp. 39–40 and 307).

Brazil and Guiana.

Habitat.—Indigenous to South America, more especially Brazil and Guiana. Marcgraf speaks of it as growing in damp and warm places, but especially on cultivated ground. Spruce (see under *G. peruvianum*, p. 215) says he had never seen it wild, and that it is nowhere the common cotton of the Indians. Cultivated in China, Japan, India (twice mentioned as wild), Malaya, Polynesia, Africa (often spoken of as wild), Mascarene Islands, Central and South America and the West Indies. Koster ('Travels in Brazil,' 1816, p. 368) says 'I have seen some species of wild cotton, of which, however, as I have neither note nor specimen I cannot pretend to give a description.'

Specimens.

Citation of Specimens.—The following, assorted geographically, are some of the more interesting examples of this plant seen by me in the Kew, Edinburgh, and Glasgow Herbaria:—China: Hainan, Dr. A. Henry, n. 8,305 (leaves broader than usual). Japan: Zollinger. India: South Ind., Herb. Rottl. (named *G. vitifolium*); Concan, Stocks, in Herb. Hook. f. and T.T.; Calcutta, Herb. Hort. Bot.; Rajputana, Duthie, n. 4,560 ('apparently wild' in Mewara, where it is called *ban kukri*); *G. nigrum*, *Ham.*, in Wight Herb., n. 177 and (Edin.), also Wight and Arnott Herb. (Glasgow). Malaya: Cambodia, Pierre, n. 802; Labuan, F. W. Burbidge; Borneo, Sarawak, Haviland and Hose, n. 3,356, Java, &c. Polynesia: Fiji Islands, Seemann, nn. 29 and 30 (incorrectly named *G. peruvianum*, *Cav.*); Vavav, Tonga Islands, C. S. Crosby; Savage Islands, Veitch. Africa: *Eastern Division*: Luabo River (Livingstone's Exp.), 1858, contrib. by Sir J. Kirk. ('Cotton Grown by the Natives'); also Highlands of Batoka; *Central Division*: Tanganika, Lieut. Cameron; Lake Nyassa (East Side), Rev. W. P. Johnson; *Western Division*: Lagos, H. Miller, 1876, n. 28; Niger Exped. Fernando Po, Vogel, n. 20, 1843; Angola, Welwitsch, nn. 5,228, 5,230 (said to be abundant and wild on the drier slopes, also cultivated about villages); *Dutch East Africa*: collected W. Busse, n. 184; Mr. Broun has recently contributed, from Khartoum, a remarkable example, said to be known as Nyam-nyam cotton, and which has the leaves broad and less deeply segmented than is customary. Mascarene Islands: Madagascar: Boivin (Nossi Be, 1847–52); Rodriguez, Balfour (Transit of Venus Exped.). America: Guatemala, S. Watson, n. 29; French Guiana (Herb. Sagot, n. 1,268); Para, R. Spruce, n. 159 (1849); Brazil, Dr. A. Glaziou, n. 8,880, also W. J. Burchell, n. 6,755; Paraguay, Gibery, n. 1,025. West Indies: Cuba: Cienfuegos District, R. Combs, n. 609; Jamaica, St. Mary's

No. 50. GOSSYPIUM BRASILIENSE, *MACF.*

Photographic reproduction of the Kew Gardens copy of Roxburgh's original MS. illustration named, "1498 Gossypium vitifolium, W." (corrected into G. acuminatum, R. in MS. of text); preserved in the Herbarium Library, Royal Botanic Gardens, Calcutta.

(in Edinburgh); Porto Rico, Paul Sintenis, determined by Garcke, n. 3625; also ex New York Bot. Gard., collected by Mr. and Mrs. Heller, n. 174; St. Vincent (Windward Islands), by Hooker (in Glasgow Herb.).

In the British Museum Herbarium, in addition to duplicates of some of the above mentioned, the following may be added, some being of special historic interest:—West Indies and Antilles: Houstoun's specimen from Jamaica (1730); Millington's samples from Barbados (named Rabbit-tail, Pollard's Rose Cotton and Trinidad Cotton); Martinique, L. Hahn, n. 492 (1869). India: Hove's Lymree and Mitampur plants (1787). Africa: Angola: Welw., nn. 5,227, 5,228, 5,231, 5,233, and 5,234, mostly this species rather than (as named) *G. barbadense*; Kæssner, n. 611 (from Kili-mukei) (1902). America: Brazil, Miers; Bahia, Blanchet (ex. Shuttleworth's Herb.), n. 95; Surinam, M. Berthoud-Coulon, n. 252 (1841); French Guiana, Sagot (1858). Malaya and Polynesia: N. Borneo, Burbidge (Veitch's Coll., 1877); Sandwich, Macrae (1825); Wight Herb., n. 177 (in Br. Mus.), is nearer to *G. peruvianum* than to present species. In Wight and Arnott's Herb. (the property of Glasgow University) the specimen n. 177 is the present species, and doubtless suggested Wight, Illust., n. 27. But on the same sheet there is mounted a specimen of *G. hirsutum, Linn.*, that may have originated Wight, Illust., n. 28*a*, and which Wight calls *G. barbadense, Linn.*

In M. De Candolle's Herbarium at Geneva (in addition to duplicates of some of the plants already mentioned), the following may be added:—French Guiana, Sagot, n. 1,268; Rio de Janeiro, Ponson, in 1828; Martinique, Hahn, n. 492; and Bahia, Blanchet, n. 246.

Schumann ('Mart., Fl. Brazil,' xii., p. 585) observes that this species is cultivated in Brazil. In support of this he cites among others the following specimens:—Pohl., n. 2,033; Peters, n. 259, Tamberlik; in the province of Ceará: Gardner, n. 1,463; in the province of Pernambuco: Forssell, n. 155; in the province of Bahia: Blanchet, n. 246; beside the river S. Franc., near Joazeiro: Widgren, n. 466; Andersson, n. 511; near Lagoa Santa: Schenck, n. 2,080; in Dutch Guiana: Paramaribo, Regel, n. 968 and 969; in the province of Columbia: Cauca ad Rio Dagua, Lehmann, n. 1,912; in the Argentina, near San Lorenzo: Lorentz, n. 373; &c.

I have quoted the above citation of specimens from Schumann to show both the distribution of the species within Central and South America (as manifested by specimens that I have not had the pleasure of personally examining), and also, in some few instances, to exhibit special forms, such as Gardner's, n. 1,463, which I certainly do not regard as being *G. brasiliense* (see p. 168), as also others, which are donbtless *G. peruvianum* or *G. microcarpum*, and not, as Schumann supposed, examples of *G. brasiliense*.

Early mention.

Nomenclature.—We first obtain information of what there seems no reason to doubt was this species, shortly after the discovery of Brazil and in connection with that country. By the earlier travellers it is spoken of as indigenous, and both wild and cultivated. It began to be known in commercial circles about the middle of the seventeenth century, but had even then been confused by botanists. Piso, for example, used the plate prepared by Prosper Alpinus of

G. arboreum to do duty as Brazilian Tree Cotton, and Lamarck (unless he included it under his *G. vitifolium*) does not describe kidney cotton at all. Moreover, the examples seen in herbaria are curiously enough more numerous and historically more interesting from Africa than from any other country. While the specimen figured by Zanoni would appear to have been derived from Brazil, Plukenet's specimen (Sloane herb. of British Museum, vol. 96, fol. 60) seems to have come from the Island of Providence (**see Plate No. 49, f. B**, also the reproduction of Plukenet's t. 188, f. 2, which was prepared from that specimen, **f. C**).

Early specimens.

It is somewhat significant that this species is better represented and, judged of from the records of its collection, has been considerably more widely distributed than any other cultivated cotton. After *G. herbaceum* (the Levant cotton) this was the species that first attracted the attention of Europe. It would thus seem possible that the large capsule and compact mass of seeds, with their copious coating of long silky floss, conveyed the impression that this would prove a very profitable plant: hence its rapid and extensive distribution and the recent vernacular names given to it that denote 'wealth.' Both Piso (1648) and Zanoni (1675) tell us that they grew it in Europe. Morison (*l.c.*) speaks of it as grown in Italy, and Jacob Breyne ('Prod. Rar. Pl.' 24, 1739) saw it at Beaumont. The seed had been procured from Brazil through Marcgraf and others by the middle of the seventeenth century.

Early attention.

Grown in Europe.

There is thus no doubt that the first kidney cotton seen (botanically) in Europe, came from Brazil, and Jacob Zanoni in 1742 called it *Xylon brasilianum*. Sloane tells us that much of this cotton was brought from Brazil by Lancaster; so also Purchas quotes many travellers who found cotton in Brazil, the most interesting perhaps being Lerius, because he describes the plant. There was thus ample time for this species to become fully acclimatised in both India and Africa long before we first make acquaintance with it from these countries, and moreover it had even then been displaced from popular favour by the Upland and Sea Island cottons of the United States.

I have chosen the name *G. brasiliense, Macf.*, for this species because Macfadyen admits having derived his information from Sloane, who in 1697 combined under the name *G. brasilianum* two or more species which Macfadyen separated and distinguished with considerable accuracy. Moreover, Sloane's specimen collected in Jamaica and preserved in the British Museum (Sloane herb., vol. 6,

Explanation of name.

fol. 65 also 66) is *G. peruvianum, Cav.*, not *G. brasiliense, Macf.* By the rule of priority, however, it is probable that Roxburgh's name for the species—*G. acuminatum*—should have been adopted. He was apparently the first author who described it accurately, but his manuscript drawing (here reproduced, **Plate No. 50**), bears the name *G. vitifolium*, and from the standpoint of the planter there might be involved some ambiguity through acceptance of a name that of necessity is suggestive of a questionable indigenous (Indian) habitat. Another alternative would be to adopt the name *G. religiosum, Swartz.*, (*non Linn.*). But the meagre description given by Linnæus, of his *G. religiosum* ('Syst. Nat.' [1767] II., 462), when read in connection with the specimen in his herbarium to which, in his own handwriting, he gave that name (**see Plate No. 32 A with labels**) leaves no room for doubt that he did not mean the Brazilian kidney cotton. In confirmation of this view it may be added that there is a sample of what may be kidney cotton in the Linnean herbarium (**Plate No. 49 A**) but which simply bears the generic name '*Gossypium*,' and was apparently neither identified nor named by Linnæus, though, curiously enough, in his own handwriting, the name 'Surin' (? Surinam) is written alongside.

Linnean specimen.

Sloane says of *G. brasiliense* that it was in his day believed to have been obtained by Jamaica from Brazil, and Macfadyen accepted that belief as sufficient justification for the name *G. brasiliense*. When grown as a regular crop it very frequently bears the name of Brazilian or Pernambuco cotton, or has some locality name given to it: thus in India it is often called 'Ava cotton' and in the Antilles 'Siamese cotton'—names suggestive of introduction. It must not however, be forgotten (as already pointed out) that the earliest accurate description and plate of this species is that given by Zanoni (1675), who calls it Pernambuco cotton (cf. pp. 18, 20). Nor must it be overlooked that the still earlier author, Marcgraf de Liebstad, according to Piso (1648), speaks of a cotton with seven conjoined seeds which was most frequently found growing in cultivated situations—a remark that would seem to imply its being spontaneous. In Brazil to-day it is often found as a plant of gardens and waste lands.

Brazilian or Pernambuco cotton.

First picture.

Whether, in the light of present-day knowledge, I am correct or not in accepting the very imperfect descriptions given by Lerius, Marcgraf, and others as denoting *G. brasiliense*, it seems highly probable that Sloane was influenced by Marcgraf and Zanoni in the

Sloane's view.

opinion he formed, as to the origin of the Jamaica stock. Macfadyen (1837) admittedly accepted Sloane's view :—'In the time of Sloane,' he says, 'as well as in that of Edwards it was known by the name of Brazilian cotton.' But whether *G. brasiliense* was and is a purely indigenous (wild) plant or is only cultivated even in Brazil, there can be no doubt that while Columbus found the aborigines of St. Domingo all but naked (a few only possessing a small piece of cotton cloth), during his second voyage the great discoverer carried away to Spain, from the West Indies and from the continent of America itself, some of the cotton *mantillas* he there found. So also in Mexico the art of cotton spinning and weaving had long anterior to the arrival of the Spaniards attained high proficiency. Purchas, for example, tells us that the inhabitants of that country were dressed in mantles 'painted throughout with works of diverse and fine colours.' Cortez was shown a map 'of woven cotton cloth with the havens and harbours near New Spain set forth in it.' In passing it may be here mentioned that in connection with the Delhi Durbar Exhibition of 1903 a superb Kashmir shawl was shown that represented a woven map of the city of Srinagar.

First cotton fabrics.

Map on cloth.

Cultivation.

It may best serve the purpose of this work to now furnish a few passages indicative of the cultivation and trade in this species, country by country, giving especial attention to the earlier authors. From the standpoint of stock improvement such historic records are exceedingly valuable, and it has been with this in view that I have hunted up the early publications and endeavoured to consider the statements made in the light of modern botanical conceptions. Most of the authors whose works have already been mentioned, and many others who may still be added, show that a century ago this was a very much more important species than it is to-day. Indeed interest in it now may be viewed as turning on its value to the hybridist. It is accordingly most important to trace out its former cultivation in order to see how far it may have contributed to the birth of the cottons at present being grown.

Value of early records.

America.—Though much has been written on the cultivation of cottons collectively, it has not been found possible to procure exact particulars of this species. We can be quite certain, however, that cotton cultivation was very ancient in Saint Domingo, Brazil, Mexico and Peru ; in fact, for centuries prior to 1747, cotton (especially balls

of thread and pieces of cloth) were in Brazil employed as money. In 1560, Duarte Albuquerque Coelho became heir to the Captaincy of Pernambuco, and sailed from Lisbon to take possession. He appointed his brother Jorge chief of the military forces. In 1565 Jorge returned from Olinda, Pernambuco, for Europe in a ship that experienced such rough weather that they had to throw overboard the artillery and many boxes of sugar and 'bales of cotton.' Thus the Portuguese must have organised the foreign trade of Pernambuco very efficiently and quickly, and the lost cargo was very possibly the first attempt at exporting cotton from Brazil. Lopez Vaz, in 1586, visited Fernambuck (as he calls it), and speaks of the town as containing 3,000 houses, 70 sugar factories, great stores of Brazil wood, and abundance of cotton. Hakluyt ('Voy.' &c., 1810, iv., p. 207) tells us that Mr. James Lancaster in 1594, after the defeat of Fernambuck, carried off several ships with cargo, among which was cotton. The first regular exports of cotton from Brazil took place a century later (cf. Cezar Augusto Marques, 'Dict. of Maranhao,' p. 13). But we may judge of the rapid change effected on Native systems when we read that in 1784 a complaint was made to the King of Portugal, by Portuguese merchants, against the Brazilian manufacturers. These were, it would seem, through the popularity of the goods they turned out, seriously obstructing the imports. Less than a century still later (1809–15), Koster ('Trav.,' *l. c.*, 1816, 366) speaking of the very area of Pernambuco, observes: 'The cotton plantations are yearly receding further into the interior, wherever the Sertam plains do not prevent this recession. The plantations of this description, which were formerly established nearer to the coast, are now employed in the rearing of other plants.' Similarly in Peru cotton cultivation and manufacture had attained a position of importance prior to the invasion of the Spanish. The subsequent histories of both these countries may be said to have marked a retrogression rather than a progression, in the cotton industries, and it is thus probable that their present backward positions as cotton-growing countries is more the result of external than internal disabilities.

First exports.

Regular exports.

Brazilian manufactures.

Manufacture in Peru.

Lerius (*l.c.*), writing of Brazil in 1557, says: 'The Barbarian women are not unskilful in gathering and spinning that Bombasin cotton, for of it they make their beds.' Does the word 'gathering' denote that it was a wild plant, the wool of which the women collected? But whether the species grown in ancient times was exclusively, or largely, *G. brasiliense*, there can be no doubt, as already

Bombasin cotton.

stated, that cotton cultivation and manufacture have a vast antiquity both in Brazil and Peru. While that is so, it is a curious accident that no sample of the plant exists, in the Herbaria examined by me, that bears a label stating that it had been found anywhere in the American Continent, in a wild or even acclimatised state. But as indicated in the paragraph that gives the vernacular names of this species, Branner mentions two indigenous and one exotic cotton as met with in Brazil; one of the former is undoubtedly the present plant.

Wild species.

Sloane's 'Catalogue of the Plants of the Island of Jamaica,' 1696, pp. 156–9, and his subsequent work, the 'Natural History of Jamaica,' 1725, II. pp. 68–72, will be found to enumerate all the more trustworthy authors on cotton. But let it be remembered the older writers hardly ever distinguished the various species, except by the occasional remark that the seeds are conglomerated into a kidney mass, or the seeds are black and naked, or, again, the seeds have a fuzzy coat. The authors who can be accepted as affording botanical evidence have already been mentioned. Some of the more interesting popular works of travel or reports on cultivation may now be indicated. Oviedo ('Hist. Nat. Ind.,' vol. I. p. 370—Pl. del Algodon—lib. 10, ch. 5) found cotton in Saint Domingo (see also 'Summary' by Eden, pp. 205, 221) indigenous and very abundant. Joseph de Acosta (1518) describes the hammocks made of cotton that he saw being used in the valley of the Amazons. Hakluyt ('Voy., Traffiq.,' &c., published 1809–12) gives the accounts of many travellers: For example, vol. v. gives Peter Martyr's 'Decades' (written 1516)—a history of the discovery of America, where frequent mention is made of cotton (gossampine) (pp. 170, 189, 192) growing like willows; vol. III. pp. 542, 545, deals with John Chilton, who visited New Spain and the West Indies in 1561, and speaks of the Mexicans making fine cotton cloth (linen). Hawks (1572, *l.c.* p. 553) makes a similar observation. Speaking of Guiana, Masham (*l.c.* IV., p. 195) mentions great store of fine cotton made into 'excellent good fustians or stockings.' Purchas ('His Pilg.,' IV., 1625) republishes the passages by Carder (p. 1,189), Sparrey (p. 1,248), Wilson (p. 1,264), Turner (1,265), Robert Harcourt (p. 1,275), Schnirdel (p. 1,351), and many others, each contributing some little item of interest.

Manufacturers in Mexico.

Azara ('Voyages,' 1790, especially the article written by Tadeo Hænke in App. to vol. II. p. 530) will be found of special interest. He tells us that the tropical parts of South America, especially Cochabamba, produce cotton in abundance and of good quality. He

South American Cotton.

urges that the tracts indicated are pre-eminently cotton countries, as they are not subject to extreme climatic disturbances. The rain falls on the mountains and is distributed to the cotton fields by rivers and canals. He gives special attention to lower Peru, where, he says, the inhabitants are noted for the care and attention they devote to the crop. They have improved their own cottons instead of having sought to acclimatise the cottons of other countries, as has been the case with the regions bordering the sea coast.

Peru.

Cotton improvement.

Rohr ('Observ. sur la Cult. du Cot.,' 1807, p. 33) tells us that according to M. Jean Kyan, the success in Sainte-Croix, with Guiana cotton, was owing to the long dry season during the flowering and fruiting period. A shower of even 12 hours does no harm, but in Guiana, when the rain sets in, it may rain for several weeks on end, thus aborting the crop completely, and an abnormally early rainy season may render the cultivation unprofitable. He further observes that each plant occupies from 10 to 12 feet, when grown on suitable soil and in a favourable locality. Rohr then adds that the true Brazilian cotton was regarded as of higher value than the Guiana, but that it had not been so successfully grown in Sainte-Croix as the former kind. The difference, he says, is in the seeds, Guiana has from 9 to 12, Brazilian only 7–9 in the kidneyed mass.

Guiana.

Early maturity.

Rohr, who in fact wrote a highly instructive little book, already frequently placed under contribution, in connection with other species, tells of his having visited most of the West India Islands, as also the mainland of South America (in company with a Dr. P. Dunkan), in order to study the species of cotton and the methods of cultivation pursued. He refers to the special stocks of the present species—the one procured from Guiana and the other from Brazil. Of the former (*l.c.* pp. 31–39) there were, he continues, several races denominated Cayenne, Surinam, Demerara, &c. 'It is of this cotton, and no other that travellers speak regarding these countries,' such, for example, as M. de Prefontaine ('Maison rustique,' 1763) and M. Bajon ('Mem. pour servir à l'historie de Cayenne et de la Guiane Française,' 1777). From Rohr's most instructive account of this and the Brazilian plant, we are justified in believing that these constituted the chief crop of the cotton planters of the West Indies, during the closing decades of the eighteenth and the beginning of the nineteenth centuries. Forms of *G. barbadense* (*G. vitifolium*) were also to be seen in these plantations, as also of *G. purpurascens*, but there would appear no doubt that prior to the production of the

Special research.

Chief crop of West Indies.

special races of *G. barbadense*, that culminated in the Sea Island stock, the planters of the West Indies put their faith chiefly on forms of this cotton, now all but completely ejected everywhere from cultivation. Rohr (as already stated) tells us that the prized forms of Guiana cotton, such as the Surinam and Cayenne, were mainly, if not entirely, cottons that differed collectively from the Brazilian cotton in having two more seeds in the kidney mass.

Now ejected from cultivation.

Birth of Sea Island.

It is, however, certain that shortly after the period here mentioned the Surinam and Cayenne cottons of commerce became forms of *G. vitifolium*, if they might not more correctly be viewed as having become hybrids of that species with *G. brasiliense*, approximating closely to the Sea Island stock of the United States. It is on this account that much uncertainty prevails as to whether Merian's picture, published originally in 1679, Rumphius' picture, published in 1750, and the specimen in the Linnean herbarium from Surinam **(see Plate No. 49 A)**, represent forms of *G. vitifolium*, or are examples of *G. brasiliense*.

Rohr shows us emphatically that both the plants mentioned had been grown side by side, and perhaps this had been so for two centuries prior to even Rohr's time.

Hybrids.

It would, therefore, be difficult to believe that under these circumstances numerous cultivated (if not even wild) hybrids between them, had not existed even from before the discovery of America. It is easy, accordingly, to account for the immense importance attached to the present species, by the early botanists, Zanoni, Plukenet, Sloane, and others. Lobel figured a kidney mass of seeds in 1576, and thus about the commencement of the period of demand for Brazilian cotton and seed; a century later the plant was even cultivated in Europe (by Zanoni), and shortly thereafter had been carried to every cotton-growing country in the world. But there remains one highly significant circumstance: namely, that when rejected from cultivation and left in a state of nature under widely diverse environment—in India, Africa, the West Indies, and America, &c.—the survival almost invariably assumes the specific characteristics of the *G. brasiliense* of botanists. Except perhaps in the Antilles and in some parts of South America the *G. vitifolium* type does not seem to be preserved in feral states. (Cf. para. on Pollen Grains, pp. 346–7, 348).

Kidneye seeds: early figured.

Feral state.

In spite, therefore, of the reports made all over the world of individual plants raised in gardens, giving an abnormally high yield,

kidney cotton is to-day the least popular of the cultivated stocks, and, moreover, its staple possesses certain properties that do not commend it to present-day industries. (See p. 298.) It was formerly, however, in much demand in Scotland and England (as I have already indicated), and for a considerable time Brazilian cotton was in fact a distinct item in the imports of Great Britain, a few years prior to the discovery of the Upland, Georgian, and Sea Island cottons of the United States. Layman ('Cotton Culture,' p. 153) says that it began to be imported definitely in 1781, and, according to Rohr, Glasgow was its first important market. Even so late as 1812 Macpherson ('Hist. European Commerce with India,' pp. 136, 223, 389) speaks of the cotton plant lately introduced, and with much success, in the southern territories of the United States of America. He then adds, 'Great quantities are brought from Brazil and the Levant; still there is also a considerable demand for cotton from India.'

Unpopular staple.

Formerly in demand in Glasgow.

Speaking of Brazil, Koster ('Trav. in Brazil,' 1816, pp. 365–9) says 'the districts which are chosen for cotton cultivation, and universally allowed to be the best adapted to its growth, are far removed from the seacoast, arid and oftentimes scantily supplied with fresh water.' 'The opinion is very general that the cotton plant will not thrive in the neighbourhood of the coast, and that frequent changes of weather are injurious to it.' 'The dry and wet seasons are doubtless more regularly marked at a distance from the sea, and if any variation is felt in such situations, it is from a want of rain, and not from a superabundance of it. The cotton plant requires that a great portion of the year should be dry; for if much rain falls when the pod is open the wool is lost; it becomes yellow, decays, and is rendered completely unfit for use. The soil which is preferred for its culture is a deep red earth, with veins of yellow occasionally running through it; this becomes extremely hard after a long interval without rain.' The plant described by Koster seems to be *G. brasiliense*. But further on he observes: 'The quality of the cotton which is produced in South America, either to the north or south of Pernambuco, is inferior to that of the province of which I am treating. The cotton of Ceara is not so good, and the cotton of Maranham is still coarser . . . Proceeding to the south the cotton of Bahia is not so fine, and the small quantity which is produced at Rio de Janeiro is not so good as that of Bahia.'

Effects of rain.

Brazilian cottons.

Bolingbroke ('Voy. to Demerary, &c.,' 1807, pp. 81, 204) speaks of the British settlers having commenced cotton cultivation on the

sea coast. But in Brazil, as already mentioned, cultivation would appear to have receded from the coast. It is often remarked in consequence that this plant requires a dry climate with moisture or rain at the growing season, but not during or immediately preceding harvest.

Lost popularity.

It has thus been shown that at an early date Brazilian cotton not only attracted much attention, but was of sufficient value for the seed to be anxiously sought after and experimentally cultivated all over the cotton area of the world. All this is very remarkable, since for many years past Brazilian or kidney cotton has taken a very subordinate position to Upland and Sea Island cottons, and does not seem likely to ever again recover its lost popularity.

Spruce ('Cult. Cot. N. Peru,' 1864, p. 70) gives the yield ascertained from a normal 3-celled capsule as 93½ grains, viz. 23 seeds, weighing 58 grains; cotton 35½ grains or 38 per cent. of gross weight. He then observes that *rinon* cotton yields a very fine silky staple of fair length, but the crop is uncertain. His description leaves no doubt as to the species, and his observation that it is nowhere in South America the common cotton of the Indians shows that even in his time it had lost its popularity.

Wild cotton.

J. C. Branner ('Cotton in the Empire of Brazil,' 1885, pp. 27–32) gives us a statement of the present cotton cultivation in Brazil written, it may be presumed, from the cultivation standpoint. In the opening paragraphs of his most valuable paper he mentions the fact that in most of the histories and other works on Brazil a species of cotton is frequently spoken of as wild or indigenous. Thus Denis ('Hist. Brazil,' p. 67) says the cotton is indigenous to Brazil. Pereira de Silva speaks of cotton as one of the indigenous plants which began to be cultivated soon after the discovery of the country. So also Auguste de Saint-Hilaire mentions the oldest travellers as having found cotton in use among the Indians along the Brazilian coast. Branner (pp. 27–32) discusses the species and varieties of cotton in Brazil, but in such a way as to leave considerable doubt as to the botany of the forms in question. In a footnote he draws attention to Burlamaqui ('Monogr. do Algodoeiro,' p. 13) where mention is made of a wild cotton ('*Alogodoeiro selvagem*') which yields so little fibre as to be not worth cultivating. He then continues,

Kidney cotton.

'the kind known as *crioulo* (*inteiro*, *arboreo* or *Maranhao*) has been cultivated, according to Arruda da Camara, since 1796.' The distinguishing feature of *crioulo* is that the smooth black seeds cling so

firmly to each other, that they only separate when pressed rather strongly between the fingers, and the fibre can be stripped without their coming apart and without leaving any lint on the kidney mass of seeds. It is a tall bush reaching from five to fifteen feet in height. The bolls are large, and the cotton clings together and never protrudes from the capsules like herbaceous cotton. This would appear to be the form designated *G. arborescens* by Burlamaqui.

Tree cottons.

The next grade is the *quebradinho*, in which the seeds separate readily from each other (? *G. purpurascens*, p. 255). In the province of Maranhao the *crioulo* and *quebradinho* are collectively described as the tree cottons. They are hardy, and if properly cared for last for several years, though they do not in Brazil yield crops worthy the name for more than two years, or three at most.

Pruning cotton.

Many writers, however, affirm that they may last for many more years up to 20, though the usual opinion is less than half that time. Gabriel Soares de Souza, who lived in Brazil in 1570–85, speaks of the tree cottons as growing for 7 to 8 years or more, provided the old wood be systematically broken off. The yield is often stated to be one quarter floss to three quarters seed. According to Capt. Page, a single plant yields four pounds of cotton in the seed.

Dwarf cotton.

The third kind of cotton discussed by Branner as found in Brazil is known by various names such as the *herbaceo, riqueza, algodao do governo, verdao, caroco, rasteiro, Malta, &c.* It does not grow as tall as either the *crioulo* or *quebradinho*, though some planters assert that it may do so. One form is specially spoken of as dwarf cotton (*rasteiro*). While the yield is good its nearness to the ground is regarded as a serious objection to it, since to keep the cotton clean necessitates repeated clearing of the ground of weeds. The seeds are separate and the floss hangs from the open bolls, but after the lint has been removed the seed remains with a green or brown fuzz. It produces from five to six times as much fibre as the other forms, and the plant is an annual, but the fibre is regarded as inferior in quality. It is hardly to be wondered at, therefore, that in practical planting the arboreous forms have been abandoned and the herbaceous substituted. The opinion prevails in Brazil that the herbaceous cotton was introduced from the United States.

Herbaceous *versus* arboreous.

The only other cotton mentioned by Branner as met with in Brazil is the *algodoim, algodoi, algodao pardo, algodao macaco, &c.* This yields a yellow or brown cotton, and is not grown to any

material extent owing to its colour and the small yield. Lastly it may be added that several unsuccessful attempts have been made to acclimatise Sea Island cotton.

Possible confusion.

The method of cultivation pursued appears to be very crude and not materially improved for the past couple of centuries or more. Auguste de Saint-Hilaire wrote 'All the planter has to do is to burn off the woods and plant his seed at the proper season.' This, comments Branner, is the whole story of the cotton cultivation of Brazil. Schumann, the most trustworthy botanical writer regarding Brazil to-day, says that *G. brasiliense* is cultivated especially in Peru and in Central America, the islands of the Antilles, and more rarely in the warm regions of the New World. It may perhaps be here added, however, that it seems highly probable that *G. peruvianum* and *G. microcarpum* are all included by Schumann under *G. brasiliense*.

Climate.

Mell ('Climatology of Cotton Districts of the Globe,' p. 67) speaks of the climate of Pernambuco as exceedingly moist, 109 inches of rain falling a year. It rains every month, the chief fall being from March to July and the lowest from September to December. The maximum temperature (mean annual) is 84·2°, the highest being in October to March. The mean lowest temperature is 71·10° and the coldest months are May to July.

The contrast between that condition (that of the coast tracts in general doubtless) with the climate of the more interior regions, must have been abundantly exemplified by the numerous quotations already submitted to the reader. But it is desirable to invite his attention to the still more strikingly different state of affairs exemplified (p. 288) in connection with the cultivation of Sea Island cotton, in order to show how very different the coast tracts of North America (the Sea Island country proper) are from those of South America (the kidney cotton country).

In his report of investigations into the weevil-resisting adaptations of the cottons of Guatemala, Cook makes frequent mention of kidney cotton as met with occasionally in the gardens of the Indians, but not as a field crop. The union of the seeds he regards as a special protective adaptation which secures almost immunity to weevil. But to carry this study to modern times it may be observed that in Guatemala, where *G. brasiliense* might be viewed as indigenous and is moreover held to be immune to weevil, it is not the cotton most extensively and systematically grown for the supply of staple. (See Cook, *l.c.*)

Immunity to disease.

Malaya and Polynesia.—In the Islands of the Malay and those of Polynesia the opinion prevails that this cotton was introduced by the missionaries or by the negroes. Descourtilz says, for example, of the Antilles that negroes who had lately arrived from Africa possessed a curious superstition. They encircle the joints of their limbs with cotton in order to remove rheumatic pains. This was written in 1827, and may thus be accepted as one of the many evidences of the influence of the slave traffic on the distribution of cotton, since presumably they carried seeds with them of a plant in which they put so much value.

Superstition regarding cotton.

Africa.—Jean-Baptiste Labat ('Nouv. Rel. de L'Afrique Occid.,' 1728, III., 262) describes a tree cotton, which he found being cultivated in West Africa, in such terms as to leave little doubt of its being the present species. It may be here observed that it appears probable that writers who speak of *G. arboreum* as indigenous to Africa may have had this plant in mind, a plant which to this day is often popularly spoken of as 'Tree Cotton,' but of course it is a very different species from the *G. arboreum* of botanists. But of Africa (as already observed) Welwitsch mentions the plant as abundant and wild in depressions and on the drier slopes of Angola, and tells us that there it bears the vernacular name *muxinha.* Sir J. Kirk ('Livingstone's Expedition,' 1858) found it in the Luabo valley, and speaks of it as 'the cotton grown by the Natives.' Cameron collected it at Tanganika, and Johnson at Nyassa.

Reputed wild.

Petherick ('Travels in Central Africa,' 1869, vol. I., 236) refers to a cotton 'which though wild is luxuriant; the blossoms both pink and yellow.' He adds that the negresses of his party picked and spun the wool, 'thus our wretched torn clothes can now be repaired,' This may or may not have been *G. brasiliense*, but no doubt was a wild or completely acclimatised species that yielded good useful cotton, and from the flowers changing colour it did not very possibly belong to the so-called Asiatic series of cottons, and therefore stood some chance of being the present plant. (Cf. p. 154.) Lugard ('The Rise of our East African Empire,' 1893, I., 431) says 'a cotton plant grows wild throughout Uganda.' Burton ('First Footsteps in East Africa,' 1894, vol. I., XXVI., also II., p. 175) says that in the Harari language cotton is *tût*, he also speaks of the city of Harar as famed for its manufacture of cotton cloth. (Cf. with *G. obtusifolium, var. Africana.*)

Mr. W. W. A. Fitzgerald ('Travels in British East Africa, Zanzibar, and Pemba,' 1898, p. 147) says: 'It was in M'Tondoa that I saw

the fourth wild cotton plant, the first being at Gongoni, the second in the forest between Melindi and Jelori, and the third at Takaungu.' In the appendix to his work Mr. Fitzgerald gives a letter from Mr. J. Weaver, of Margarini Plantation, in which the following passage (p. 638) occurs: 'In returning lately from Mombasa I landed at Kilifi, and walked up, and in passing Roka I noticed some wild cotton that was looking extremely well, and on examining it found it to be "Kidney Cotton." Please notice from the small sample sent the peculiar arrangement of the seeds—they are like kidneys.' It should be noted that the opinion of the luxuriance of the wild plant was expressed immediately after having reported somewhat unfavourably on the crops of Sea Island cotton experimentally grown at the plantation.

Soudan tree cotton.

Egypt.—Through the kind co-operation of Mr. Broun, as well as of Mr. W. Lawrence Balls, I have had specimens of this cotton sent to me from Nyam Nyam, in both cases with the same remark that it is the Tree Cotton of the Soudan. With the single exception of the specimen in De Candolle's Herbarium (mentioned under *G. vitifolium*, p. 258), I have failed to discover in any Herbarium an authentic specimen of the plant which was taken to lower Egypt in 1820, and which led to the modern cotton cultivation of the Nile basin, but I am still nevertheless satisfied, from the statements made by writers on this subject and from the study of the Egyptian cottons,

Jumel cotton.

that M. Jumel's white cotton which he found at Cairo and carried to Alexandria was the same species as the tree cotton of the Soudan to-day, viz. *G. brasiliense*. At the very time mentioned Surinam and Brazilian cottons were being experimentally tried in India (see below) and in most cotton-growing countries, because of their then high reputation. In the 'Bulletin du Ministère de l'Agriculture' of France, interesting particulars are given regarding Jumel cotton. M. Jumel, who was a Frenchman, had remarked in the garden of one of his friends living near Cairo, certain cotton plants, of which the seeds had been imported from the Soudan. He succeeded in cultivating the plant from seeds which he obtained, and presented certain of them to Mehemet Ali, who, foreseeing the sources of wealth that the cotton might assure to the country, placed at the disposal of Jumel vast extents of territory, and gave him every

Compulsory cultivation.

facility in his enterprise. This cotton was also known by the name of *mako*, after a Bey in whose gardens Jumel had originally found the first seeds. Several writers on Egypt speak of the Khedive having at first made the cultivation of this cotton compulsory, and

affirm that without that action the industry would have taken a much longer time than it did to assume importance.

Heuzé (*l.c.* 141) says that in Egypt to-day the cotton generally called Jumel's belongs to the series with fuzzy seeds. (Does Heuzé here allude to the Hindi Weed'?) He there at all events seems to express the popular opinion, but adds his own view: namely, that the plant brought by Jumel to Egypt belonged to the series with black naked seeds, and was the same as the cotton of Bahia, which, he adds, they still cultivate in Egypt. He thus apparently held the view here set forth that it was *G. brasiliense*. (Cf. remarks above under *G. peruvianum*, pp. 219–20.) Jumel cotton.

A remark made by Foaden seems to have a direct bearing on the issue here raised; speaking of the origin of the varieties of cotton grown in Egypt he says: 'All that can be asserted with safety is that out of the varieties existing in the country "ashmouni" cotton was evolved, and of the varieties at present cultivated in Egypt this is the oldest.' Thus the belief seems to be entertained that Jumel's cotton was crossed by the so-called indigenous stock, the result being the evolution of the present stocks. (See pp. 219, 223.)

India.—It may now be useful to give in conclusion the Indian experience. It can almost be said that every decade or so, for the past century, some one has announced a discovery of the greatest importance, viz. a truly wild tree cotton with a long silky staple. In most cases the plant of these discoveries has been *G. brasiliense*. Indian writers usually, however, speak of *G. brasiliense* as a cultivated plant, or one found in the vicinity of cultivation. Still for the reasons given (were speculation permissible) it might be affirmed that it had been recorded in a more complete state of acclimatisation in Africa than anywhere else. Hove collected it, however, in Gujarat in 1787, but does not say whether wild or cultivated. His specimens may be seen in the British Museum. Macpherson ('Hist. Europ. Com. with Ind.,' 1812, pp. 40, 389) deals with the cotton trade of India, and observes that cotton 'has lately been introduced with remarkable success in the southern territories of the United States of America, and that great quantities are brought from Brazil and the Levant.' This may perhaps be accepted as showing the close connection that existed between India and South America during the period of the East India Company's greatest prosperity. 'Of late the vast demand for cotton in Great Britain has enriched all the countries which produce that important raw material, and among the Met with in Gujarat.

rest the Portuguese colony of Brazil.' Roxburgh may have been publishing the opinion held by his contributor (Mr. Robertson, 1800) when he said that it was believed to be a native of the mountains 'to the north and westward of Bengal.' But in the MS. copy of the 'Flora Indica' (preserved in the library of the Kew Herbarium) he gives a different story. 'Native of the mountains to the northward of Bengal, at least the seeds were sent to me from Farrackabad, under the name hill cotton.' In that copy Roxburgh in his own handwriting corrects the name *G. vitifolium, Linn., Sp. Pl. ed. Willd.*, III. 804, into *G. acuminatum, R.* He also furnishes a detailed description not given in the 'Flora Indica.'

Roxburgh's MS.

Azara ('Voyages dans L'Amérique,' conducted in 1781, vol. II., p. 530) pays a high tribute to the East India Company in that they had procured from Cochabamba seed of the South American cottons, and grown these on the coast of Coromandel and in Bengal. If any such evidence had been necessary we have here from a South American explorer the direct statement of the introduction of the kidney cotton into India. Wallich re-examined the evidence of an Indian habitat, and came to the conclusion that it was only an acclimatised plant in India, and had come very possibly from Surinam in Guiana. And, in still further support of this view, we read in a note on Indian cotton, written in 1829 by Mr. Henry St. George Tucker, that Lady Hastings grew this cotton in an experimental farm at Futteghur near Calcutta. Still earlier, viz. in 1808, Roger Hunt addressed the East India Company on the causes of deterioration of Pernambuco and Surinam cottons. Mr. Charles Lush in 1839 told the story of the introduction of Pernambuco cotton into Western India, the plant which Hove collected in 1787, so that some time before Roxburgh had had his attention directed to this plant we have abundant evidence of its introduction into India.

Enterprise of E. I. Company.

Lady Hastings.

It need therefore be no surprise to learn that in Rajputana Duthie found *G. brasiliense* 'apparently wild,' and bearing the vernacular name *ban-* (wild) *kukri.* Mr. Burkill, during a recent exploration in Burma, made a somewhat similar discovery. In a communication on this subject he informs me that 'It produces a beautiful silky and long fibre of much greater value than the other cottons of Burma, but nowhere is it a field crop. It is chiefly to be found in Tenasserim, and is even more plentiful in Amherst toward the Siam border than in the much moister climate of the coast. It occurs in gardens at Pegu, and at Kyaukse (in the irrigated tract) it

Apparently wild.

grows, but with diminished vigour. I have also seen specimens of it from Mingin (Upper Chindwin) and from Minbu.' In another part of his report, Mr. Burkill gives it the Burmese name *themban-wa* (=ship cotton), and speaks of the seeds as being half covered with fuzz; he also makes other observations that suggest a possible confusion with *G. microcarpum*.

More recent discovery.

Perhaps the most recent discovery in India of a tree cotton with long staple occurs in a communication addressed to Sir W. T. Thiselton-Dyer which was submitted to me for opinion. The sample that accompanied the letter proved to be *G. brasiliense*, and in my reply the following observation was made:—It is an exotic in India, and has remained a curiosity in gardens or become a naturalised weed on roadsides, or even passed into the jungles adjacent to its former experimental cultivation, purely and simply because, in spite of the superior quality of the floss, its cultivation has proved less remunerative than the indigenous stocks.

From a long personal acquaintance with cotton cultivation I can say that nowhere in India has kidney cotton seemed to me to have given evidence of capacity to become a regular field crop. The staple is long and of excellent quality, but the yield poor and the perennial habit against it, since the plant has often to live through seasons unsuited to its growth, and which thus retard its yield during the favourable months. Its being a perennial is also a circumstance that conflicts with the agricultural conditions of a large portion of the cotton area, since the essential rotation to preserve the fruitfulness of the soil is interfered with. There would, moreover, seem to be a still further and perhaps even more powerful argument in favour of annual quick-ripening cottons: namely, that they can be grown and reaped before the appearance of dangerous pests such as the boll-weevil.

Conflict with agriculture.

But the interest to India in its acclimatised stocks of this plant may possibly in the future be found to lie in these being employed to hybridise with imported superior stocks that it may be desired to grow in India. In this connection therefore, the observations made in the chapter on Pollen-grains (p. 346) may be found of special interest, since these would tend to the belief that even Sea Island cotton is but a hybrid stock derived from the present species as one of its ancestors. If this be confirmed, then, the acclimatised stocks of India may be found invaluable in breeding experiments.

Acclimatised stocks valuable.

SECTION V.—Naked-seeded Cotton with Bracteoles quite free and Floral Glands absent.

BRACTEOLES *free, ovate rotund, deeply auriculate;* GLANDS, *both internal and external, absent;* SEEDS *quite naked, striated, floss easily removable;* LEAVES *very large, deeply cordate, and five-palmatifid, glabrous or nearly so, but with glands on all the veins below.*

There is only one species, so far as known, belonging to this section, viz. that from East and Central Africa. It has never been seen under cultivation.

ANALYTICAL KEY TO THE SPECIES.

Stipules large oblique, stem-clasping
42. *G. Kirkii.* . . . below.

42. G. KIRKII, *M. Mast.*, *Journ. Linn. Soc.*, XIX., (1881) p. 212–4.

Description.

Leaves 5- or 3-palmatifid, deeply cordate, sub-glabrate, glands prominent on all the veins below **(f. 1)**; petioles long stout; stipules large, conspicuous, obliquely-ovate, stem-clasping; bracteoles 3, free, thick but not clawed, woolly, deeply auricled, coarsely toothed; calyx relatively small, minutely toothed, thick, woolly within **(ff. 2 and 3)** veins not visible; seeds free, ovate, smooth polished, black, with grey lines **(ff. 5 and 6)** that indicate the origin of the short rust-coloured readily separable wool. **(See Plate No. 51.)**

Branches square, as also the petioles and peduncles, and all densely coated with short matted grey stellate hairs. *Leaves* ovate, acute, cordate, two-thirds segmented into 5 lobes (the upper leaves on the flowering shoots only 3-lobed), 1½ to 3 inches long by 2 to 4½ broad, the central lobe by far the largest; lobes oblong acuminate, with bristle tips, constricted below into the open rounded sinuses, stellately hairy on the veins and reticulations, otherwise glabrate, gland-dotted, and with prominent glands on the mid-ribs of all the lobes, the glands of the central and first laterals well within the lobes, those of the lower pair within the blade proper; in the herbarium the under surface of the leaf seems always to dry into a slaty-grey, the upper into a brown-black colour—peculiarities that are very characteristic; *petioles* 3 to 5 inches long; *stipules* very conspicuous, short but broad and obliquely ovate, embracing or clasping the stem. *Inflorescence* abundant short lateral shoots, not much longer than the leaves, but each supporting two, or it may be only one flower, and two or three small leaves; *peduncles* and *pedicels* conspicuously 4-angled; *bracteoles* 3, free from each other, not clawed, in bud looking almost like a bivalved shell owing to the third and smaller bracteole being pushed on one side and compressed between the outer larger

M. Smith delt, J. N. Fitch lith.

West, Newman imp.

No. 51. GOSSYPIUM KIRKII, *M. MAST.*

1, Flowering shoot, with persistent stipules, numerous glands, and woolly bracteoles; 2, bud showing internal glands; 3, calyx opened out showing whorl of hairs; 4, ripe fruit and subtended bractcole; 5, seed natural size, showing floss; 6, floss removed, a portion often adhering to apex; 7, seed enlarged showing smooth, polished surface and lighter coloured bands.

ones that are ovate rotund, deeply auricled (almost peltately attached), thick, coarsely and conspicuously toothed, tomentose on both surfaces, especially when young, accrescent and submembranous on the fruit, which they completely enclose. *Corolla* small, tube very short, petals obovate, almost uniform, that is not oblique, with a well-marked darker coloured spot near the claw, outer surface looking striated, owing to the assortment, in transverse lines, of very short compact stellate hairs. *Calyx* small, campanulate, truncate, minutely toothed, thick woolly, veins not visible, but a ring of glands placed near the base on the outside and a corresponding tuft of fairly long hairs on the inside. *Fruit* small, rotund ovate, 3- or 4-celled; *seeds* few, ovate, smooth, polished, free from each other, not angled through being compacted together, as in most wild species, but striated with grey bands that correspond with the lines along which the short, dark, rust-coloured wool is attached (a striation that recalls the markings on the seeds of *G. brasiliense*); *wool* so readily separable as to usually show only the tip of the seed with a minute tuft of hairs adhering (ff. 5 & 6). For an account of the pollen-grains see p. 348.

Tropical Africa.

Habitat.—East Tropical Africa, purely wild and never apparently cultivated.

Specimens.

Citation of Specimens.—The following are examples seen in the Kew Herbarium:—Dar-es-Salaam (1869), Sir J. Kirk; N. Bote on Umba River, by Kæssner, n. 28; Dodori, East Africa Protectorate, Tanaland (top of low hill, Mundane Range), by Brand. Recently a further supply has come from Malindi, East African Protectorate, where it is said to be found in remote forests truly wild. In the British Museum, North of Mombassa to Lamu and Witu, collected by A. Whyte (1902).

Possible hybrids.

Nomenclature.—This plant has, in what might be called its external appearances, a strong resemblance to *G. brasiliense*. In fact, although I can discover no record of any practical tests that would support the suggestion, I am strongly tempted to speculate that it may have contributed to the production of some of the special African cultivated races attributed to that species. The leaves of *G. brasiliense* in shape, texture, comparative absence of hairs, and the colour into which they dry in the herbarium, are distinctly suggestive of the wild *G. Kirkii*. The stipules of *G. brasiliense* (and some of the other plants associated with it) do not, it is true, become so pronounced as those of *G. Kirkii*, but they are nevertheless the most conspicuous stipules of all known cultivated cottons. Lastly, the undoubted abundance of *G. brasiliense* in Africa, often met with in a state of complete acclimatisation, and the claims sometimes made for its being even indigenous, may be accounted for by this purely African species having been mistaken for Brazilian cotton. But there is perhaps no other wild species more worthy of careful study than the

present. In another place (p. 153) it will be seen I have pointed out that the special race of *G. obtusifolium*, characteristic of Africa, possesses certain peculiarities that bring to mind *G. Kirkii*, so that it would appear probable that, though never cultivated, the present plant may have still exercised a powerful influence on the cultivated cottons of the African Continent.

CHAPTER IV

IMPROVEMENT OF THE COTTON PLANT

In this chapter it is contemplated to focus the practical results exhibited by the foregoing observations on the subject of cotton improvement. The cultivated cottons of the world have been referred to three great areas: (*a*) Asia, (*b*) Africa, and (*c*) America. But it has sometimes been affirmed that the two first can be taken together and spoken of as the fuzzy-seeded Asiatic, and the other as the naked-seeded American cottons. It has been abundantly shown, however, that this would be most inaccurate, since all the fuzzy-seeded species are certainly not Asiatic, no more than are all the naked-seeded American forms. A more accurate conception is that given above: namely, fuzzy-seeded cottons with united bracteoles (Section II. p. 77) and fuzzy-seeded cottons with free bracteoles (Section III. p. 163). The former is the Asiatic group and the latter the American fuzzy-seeded. Moreover the wild species have the seeds either with a firmly adhering coat of wool or a readily separable floss. And even the condition with both a fuzz and floss is not unknown in a few wild species, or at all events fully acclimatised or feral states. Classification.

Mr. C. F. Cook ('U.S. Dept. Agri. Bull.' No. 88 of 1906) thinks the very existence of the wool may be a consequence of the necessity to protect the seed from the boll-weevil and other such enemies of the plant. In most wild forms, such as *G. Stocksii* and *G. Davidsonii*, the wool is so firmly and intricately crumpled up around the seed that it might easily enough prove a veritable proboscis-proof protection. It is in fact so compact as to cause such seeds to be sometimes described as naked, the fuzz having escaped detection. But boll-weevils or other boll-perforating insects are not known to be present, in at least some of the localities of wild species of *Gossypium*, though a woolly coating of some kind is universal. Seed protection. Boll-weevil.

Of wild species the following among others possess a short velvety coating around the seed:—*G. Harknessii* (a native of California); *G. Palmerii* (of Mexico); *G. Sturtii* (of Australia), and *G. tomentosum*

Wild cottons.

(of the Hawaiian Islands). On the other hand the following have naked seeds :—*G. Kirkii* (of East Tropical Africa), and *G. taitense* (of the Polynesian Islands). But in passing it may be here observed that no Asiatic indigenous cotton has a naked seed. And lastly the majority of the Asiatic fuzzy-seeded cottons have the pollen-grains covered with opaque triangular spines (**see Plates Nos. 52, ff. 7, 8 and 9, and 53, f. 15**) while the corresponding American series have the grains mostly with a thin palisade wall (**see Plates Nos. 52, ff. 5, and 53, ff. 14 and 17**) and sometimes a few straight hyaline spines. But let it be here added that there is at least another great group of cultivated cottons characterised by the existence of very large hyaline triangular spines that seem as if buttressed on to the intine. This to some extent coincides with the naked-seeded cottons (**see Plate No. 53, ff. 11, 16 and 20**). The manifestation, therefore, of these peculiarities, in certain cultivated or long acclimatised plants, may safely be regarded as denoting definite influences and not accidental sports nor even climatic adaptations.

I have elsewhere (pp. 27–36, 41–2, 55, 118, 203, &c.) given many particulars regarding the colour, shape and twistings of the floss,

Red floss.

and advanced arguments in favour of the red floss being regarded as the generic type. Accepting that view it is only natural to anticipate that a red floss would appear and reappear in all cultivated cottons when neglected or grown under unfavourable influences, the dominant condition being brought out on the disappearance of the acquired characteristics. It is interesting to record, therefore, in this connection that numerous writers have observed these peculiarities even long anterior to the period of their explanation on the theory of hybridisation. For example Spruce ('Notes on Cult. of Cotton in Piura and Chira in N. Peru,' 1864, pp. 47–8) says 'if a number of seeds taken from pods of perfectly white cotton be sown together, a few of the plants are sure to produce only brown cotton, and the browner it is the shorter and more brittle the

Degeneration.

staple: so that the brown cotton plant is a mere degeneration from the white. And yet the lint is rather pretty—to the Indian's eye, so much so, that he formerly considered it sacred, and limited its use to his priests and Incas, and to his dead; and at the present day he weaves it alternately with the ordinary white cotton in stripes and checks in his *mantas* and *listados*.' So again in a further page he adds, 'It matters little whether we call these kinds—species, varieties or races. They are easily distinguished in the living state, and differ

much from one another in the period of maturity and the quantity and quality of their yield; nor are new forms readily produced even where many kinds are grown side by side.'

Hybrids.

It has sometimes been upheld, but with little justification, that the crossing of fuzzy-seeded and naked-seeded cottons (the so-called Asiatic and American cottons) was impossible (see p. 165, 190, &c.). But there is perhaps no subject on which greater diversity of opinion exists, than that of the value (or even possibility) of hybridisation within the genus *Gossypium*. One set of writers affirm that it is difficult to prevent hybridisation; while another stoutly upholds the belief that it is of no practical value, if they do not indeed go so far as to deny absolutely its accomplishment in nature. A parallel to this diversity (and perhaps a consequent one) is the degree of acceptance of the species as established by botanists. Some writers, such as Todaro, think there may be as many as fifty-four species, while others, such as Parlatore, reduce them to seven, and Aliotta (followed by Wildeman, cf. Fasc. IV. of Mission of E. Laurent to Congo, 1907, pp. 389–95) to five, with numerous varieties and cultivated races or hybrids under each. Buchanan-Hamilton went even further, and reduced all to two (or perhaps three) species, viz. the black (naked) seeded and the white (fuzzy) seeded, with as a third the red (*khaki*) seeded cottons. In a letter written to Wallich (in November 1828) Hamilton says 'Although I am inclined to think that there is really only one species of cotton plant, this is to be taken in the sense used by the botanists of the true Linnean school; and by no means supersedes the necessity of choice in selecting seed of a good kind for cultivation. A Crab apple and a Newington Pepin belong to the same species, but you may work to eternity with the seed of a Crab without producing one eatable apple, much less a Pepin.' (Prin, 'Sketch of the Life of Francis Hamilton (once) Buchanan,' p. xxxv).

One species of cotton.

The controversy regarding the number of species dates from even before the formation botanically of the genus *Gossypium*, but I venture to think it could never have existed, and cannot exist to-day, when the undoubted wild forms are made the basis of classification.

Arboreous cottons.

Arboreous versus Herbaceous Cottons.—To understand this subject fully it is necessary to carry our study a little further back, and to investigate some of the primary conceptions in the formation of cultivated plants. The history of cotton improvement, so far as it has been written, would seem to point to certain important phases or stages. The story opens with primitive man content with

collecting from wild arboreous forms the supplies of the staple which he required (see pp. 10–12). In Southern Asia and Arabia the plant first so used was mostly *G. arboreum* (see pp. 83, 85, 87, 135–6). When we make acquaintance with America (more especially Brazil and Peru) an expert knowledge in cotton is found to have been quite as ancient as that in Asia, Africa and Arabia, and the cotton first brought to us from the New World was again a tree cotton, but a totally different species, viz. *G. brasiliense* (see pp. 18, 20).

Annual cottons.

In both hemispheres it would seem to have been early realised that to meet the demands for cotton, regular agricultural stocks were essential, and annual plants were then preferred to perennial. But there appears to have been a transitional stage, between tree and herbaceous cottons: namely, that of periodically cutting down or ratooning perennial stocks (see pp. 94, 259, &c). The attainment of purely annual plants was a direct consequence of cultivation to climate. No species of *Gossypium* is known, in its original habitat, to be an annual. When carried to regions where the climate (for part of the year) was unfavourable to cotton, perennial stocks could obviously not be grown, and annual forms became imperative. Selection for early maturity would doubtless soon lead to the production of plants which, from sowing to reaping, would not require more than six or seven months, so that they could be off the fields before the advent of the unfavourable months. Moreover, they could be alternated conveniently with other crops, and thus not interfere with the necessary rotation required to secure the natural balance and fertility of the soil. Early harvesting would be, at the same time, an important safeguard against pests and blights known to recur at certain seasons of the year.

Ratooned cottons.

Triumph of agriculture.

The first great cultural triumph, therefore, was the production of annual crops or plants that would yield their fleeces within a limited period determined by climatic conditions. This discovery allowed cotton cultivation to be carried beyond what might be called the natural geographical area of the genus, and accordingly vastly increased the possibility of its production. As the annual crops crept gradually into prominence, the cultivation of the perennials dwindled into insignificance and the craft passed at the same time from the hands of ignorant into those of skilled cultivators. (See pp. 15, 80, 136, 159, &c.)

Asia Minor.

Centres of Specific Influences.—In Asia Minor (and possibly also Abyssinia) one of the greatest of the annual stocks was thus produced,

viz. the plant now known as *G. herbaceum*. This became distributed from the shores of the Caspian, the Black Sea and the Mediterranean south and south-eastward to Egypt, Abyssinia, Arabia, Persia, and the frontier of India. It was the cotton plant first seen and cultivated by Europeans (see pp. 155–63).

India: Africa.

In India itself, and probably also in Africa as well, another great annual stock originated, namely *G. obtusifolium*. This, while closely associated with the ancient Hindu civilisation, as well as with the rise of the world's modern trade in cotton, has not been cultivated very much beyond the limits of the countries of its original production (see pp. 139–55)

Central Asia: China.

But there exists what may be called a third great Asiatic species, namely *G. Nanking*. Where this exactly originated, as a cultivated stock, cannot, I am afraid, be definitely ascertained, but it is met with from the Caspian westward through Turkestan and Central Asia, and lapping over the Himalaya it enters India in one or two directions, and is finally distributed to Burma, Siam, China and Japan. It exists, however, even more frequently as a perennial than as an annual, and has possibly not as yet attained its highest development. Its pollen-grains are structurally nearer to those of certain American fuzzy-seeded cottons than to those of any Asiatic species (see p. 345). So far as historic evidence goes the Chinese would seem to have procured their stock of cultivated cotton through the Arab traders, somewhere about the tenth century. But it by no means follows that the Arabs carried this particular species to China. A cotton plant was known in China before cotton fibre cultivation engaged attention. The present species stands every chance in fact of being indigenous to some part of the vast area of China itself or of Central Asia. It is a mountain-loving form that does not demand proximity to sea influence, but will luxuriate in the interior of continents (see pp. 114–39). But it may be questioned how far it is a pure species. Many of the better known races would seem to be undoubted hybrids.

Mountain-loving species.

Such then are some of the classic areas and species, but with the discovery of America several new phases in the story of cotton dawned on the civilised world. A species previously unknown to Europe and Asia at once attracted attention, and, for perhaps a century, held sway as the most important cotton of the world. It was described as 'the very excellent American cotton with green seeds.' Elsewhere (see pp. 19, 186–9, 192, &c.) I have shown that we have every reason for

Green-seeded cotton.

believing that the great English gardener of the eighteenth century, Philip Miller, was closely and honourably associated with the discovery and distribution of this new stock, and to that cultivated plant Linnæus gave the name of *G. hirsutum* (see pp. 183–204).

There is every probability, however, that it was derived from *G. punctatum* (see pp. 44, 168–82), the wild species that I have characterised as demarcating the fuzzy-seeded cottons of modern commerce. It will be seen, moreover, that I have accepted two varieties of that species, one indigenous to the eastern shores of America from Alabama to Costa Rica (see pp. 170, 172), the other to the west coast tracts of Africa (see pp. 170, 173–4). It is possible, however, that these should be viewed as species, not varieties. If my theory be correct we have accordingly two great and distinct strains in the forms of *G. hirsutum* cultivation, the one African, the other American. But to these were rapidly linked a long succession of other influences, and henceforward the progress made, especially in America, may be described as not only vigorous, but phenomenal. The first and most valuable of these came from Mexico and may be spoken of as represented by *G. mexicanum* (see pp. 226–41). It seems likely that a flood of light may be thrown on the study of American cotton by a critical examination of the forms that have survived on the Galapagos Islands (see p. 69).

American and African wild cottons.

So in the same way Central and South America were found to possess several very distinct cultivated cottons, as well as a fairly extensive assortment of wild species, many of which, on the great industry of the United States coming prominently into existence, at once commenced to exercise their varied influences on the rapidly multiplying new stocks (see pp. 204–26).

Central and South America.

Improvement was pushed forward in most parts of the cotton area, but in the United States the Uplands gradually advanced into larger leaved and less hairy forms, thus accentuating the distinctive peculiarities of *var. jamaica*, by hybridisation very possibly with *G. mexicanum*. In Africa, on the other hand, the more distinctly *G. hirsutum* (*var. nigeria*) type was preserved, though when carried to the United States this also was developed and hybridised, thus originating a more hairy series, but one that is otherwise parallel with that traceable to *G. mexicanum*.

History of Upland cottons.

From South America (Venezuela and Guiana, &c.), as also from the Antilles, there came still another great cotton, one spoken of as black-seeded, because its long silky floss separated readily from the

Black-seeded cotton.

seed, which then appeared black and naked. This was originally named *G. barbadense, Linn.* (see p. 265) and subsequently *G. vitifolium, Lamk.* (see p. 255). On its becoming an annual it spread north, along the successive chains of islands, and seems the while to have rapidly improved until, by hybridisation with *G. brasiliense* very possibly, it assumed the condition of the finest of all known staples—the Sea Island of modern commerce (see pp. 275–95). The species *G. barbadense* was largely founded on a description and figure published by Plukenet, but neither his specimens (nor any of the older samples in herbaria) bear the record of having come from Barbados, so that it is not quite clear why it got the name *barbadense*. Subsequent writers accepted (and perhaps naturally so) Lamarck's *G. vitifolium*, and confessed themselves unable to recognise the older Linnean plant. In another place I have given a photograph of the actual original type of *G. barbadense* (**see Plate No. 46 A**), and it will be seen to be very much nearer to *G. vitifolium* (**Frontispiece**) than to the highly specialised modern Sea Island cotton (**Plates Nos. 46 C, 47 and 48**). It has accordingly seemed to me desirable to accept Todaro's suggestion, namely to separate the Sea Island cotton, which I do, as *G. barbadense, Linn., var. maritima.* But I am by no means satisfied that there may not be one or two forms commonly treated by authors as *G. vitifolium*, and I accordingly retain Lamarck's plant as distinct from the Linnean species. *G. vitifolium* is, moreover, often recorded as met with in a wild state, and on that account its retention as a species seems desirable. Botanically, however, *G. barbadense, Linn.*, being the older name, *G. vitifolium, Lamk.*, so far as it is at present known, should be reduced to the position of a synonym under, or at most as a variety of, that species.

Sea Island cotton.

But from the south of the Equator there came several cottons two or three of which require to be here specially mentioned, such as the naked-seeded Bourbon cottons (see pp. 250–5), the fuzzy-seeded Peruvian cottons (see pp. 213–26) and the kidney-seeded Brazilian cottons (see pp. 295–315). Lamarck, Roxburgh, Royle, Wight and many other botanists seem to have thought that all the so-called black-seeded cottons were of necessity forms of *G. barbadense*, hence the confusion that for long prevailed regarding the Bourbon cottons (*G. purpurascens*).

Southern cottons.

Far away to the south in the Windward Islands (at Tahiti) a wild species abounds (*G. taitense*) (see pp. 246–50). This appears to have

Bourbon cottons.

originated the Bourbon cottons—a group which obtained the name Bourbon through the close connection of the French colonists with the production and distribution of these special cottons. This naked-seeded stock would appear to have contributed by hybridisation toward the formation of the partially naked-seeded and readily separable flosses seen in some of the so-called Upland cottons of America. I have repeatedly alluded to the tomentum of the leaf as often showing a relationship to the character of the floss. The tendency in America would seem to be toward glabrous leaves and long silky readily separable floss (see pp. 194–5, 247), while in India it would appear an opposite condition prevails: namely, toward tomentose leaves with long silky firmly adherent floss. In the former series I have presumed *G. purpurascens* was the recessive element of the hybrid that accounted for that tendency, whereas in the latter there would seem little or no doubt *G. hirsutum* has the corresponding though opposite influence (see pp. 59, 88, 162). By the exhibition of remote gametes in hybrid experiments the reappearance of these two species should, therefore, be no unusual circumstance (see p. 111). *G. peruvianum* and *G. microcarpum* are, it would seem, very probably also hybrid stocks that owe their existence to the presence of the fuzzy-seeded American forms spoken of as being indigenous to Mexico (see pp. 204–10). The crossing of the S. American naked-seeded *G. vitifolium*, with one or other of these fuzzy-seeded plants might be anticipated as likely to afford the type developed into *G. peruvianum*. If it be found impossible to discover (in the future) an indigenous source for *G. mexicanum*, *its* origin might similarly be looked for as a hybrid between *G. purpurascens* and one of the wild fuzzy-seeded Mexican species.

Recessive form.

Peruvian and Mexican cottons.

Brazilian cotton.

This leads me now to allude to *G. brasiliense*—the kidney-seeded cotton (see pp. 295–315). Historically there would seem little doubt this came originally from Brazil, though the plant seen by Sloane in the West Indies (his specimens of which are still preserved in the British Museum) and which he described under the name *G. brazilianum* ('Pl. Jam.') are in reality *G. peruvianum*. This fact thus affords the earliest known date (1697) when *G. peruvianum* was at least known and cultivated. Fully a hundred years previously, however, John Lerius, in his 'History of Brazil,' described the kidney-seeded cotton of that country. Prior to the discovery of Sea Island cotton (or at all events to its cultivation in the Sea Islands of America), Brazilian cotton was imported into Great Britain, and enjoyed the reputation of

Imported into Europe.

being a new and much improved stock, on the Levantine supply, which alone came, at that period, to the markets of Europe. To the high appreciation with which it was received (at so early a date) is due doubtless the wider and more complete distribution of this species than of any other cultivated cotton. But to the apathy, if not wilful opposition, of the Spanish authorities has to be attributed at least some share in the decline of interest that rapidly ensued. It exists to-day in Africa, India, and other countries, in a state of complete acclimatisation, but neglected doubtless through the subsequent discovery of more valuable cottons. It is, moreover, significant that in no Herbarium examined by me is there a specimen of this plant from Brazil, or from any part of South America, with the observation recorded of its having been found in a wild state.

But I need not dwell on these and such like suggestions further in this place, since I shall have occasion to revert to them again while discussing the value of *Hybridisation as an Agent in Staple Improvement*. My present object may be accepted as fully accomplished: namely, to enforce recognition of the fuzzy-seeded group of Mexican cottons, as constituting a centre of influence hitherto entirely overlooked. Hence it may be added that the proximity and close association of wild species with the known centres of production of special cultivated stocks is highly suggestive of their influence, especially when it is observable that certain of the specific characteristics of the wild species appear in the cultivated stocks.

Important influence.

Methods of Improvement of Stock.—There may be said to be three methods. *First*, systematic selection of forms that appear spontaneously in the fields, and which seem better suited to environment or possess some special quality such as being blight-resistant (see pp. 241-4), or manifest a desirable property such as superiority of fibre. *Second*, natural and artificial hybridisation of species and races along lines calculated to secure an intermingling, strengthening, and fixing of points of merit. *Third*, acclimatisation of approved stocks from one country or locality to another.

Three methods.

All three methods are of value, and have, therefore, to receive careful consideration, but the last is usually the least hopeful, especially when the supply is brought direct from remote regions with widely different climatic and other conditions. Acclimatisation is, however, in some respects the method that commends itself most readily to many cultivators and casual investigators. A stock is much advertised: it is argued that it will cost but a small sum to procure a supply and

if failure results there can be no great harm done. That is an error far more more serious than such persons realise. Every promiscuous experiment not only defers systematic investigation but adds a new disappointment that in time is certain to give the disastrous impression namely that all endeavours at improvement are fruitless. Acclimatisation should only be attempted after the most careful study of the environment of the original and the proposed new country of production. And as a rule it is safer to bring the stock through a succession of stages or regions and conditions than direct. It has only been by gradual transitions, for example, that perennial stocks of equatorial regions have been changed into annual crops of temperate tracts. The remarks made on this subject regarding *G. barbadense* (p. 272) might be consulted.

Study of environment.

Degraded states.

Selection of Stock.—In the United States of America it has practically become an accepted axiom that successful cotton-growing imperatively involves the systematic selection and annual production of special seed (see pp. 282–3). How far this first method (selection) may be but the casual and accidental application of the principles involved in the second (hybridisation), is a point that needs elucidation. Selection may, at all events in the majority of instances, be characterised as necessary to preserve the quality of existing stocks (see p. 30). In other words, with most cultivated cottons the tendency might be spoken of as retrogressive, however fertile the soil or favourable the climatic conditions (see pp. 147, 191, 199, etc). That is to say, there is manifested a constant tendency to part with properties that may be valued and to assume (from the cultivator's standpoint) lower or degraded states. Such degeneration may, however, be witnessed as being almost invariably towards certain manifestations that have specific significations. Hence it may be accepted that selection alone has not originated all the forms of cultivated cotton known in the world. Thus *G. arboreum*, an admitted Asiatic species, has been carried, in certain cultivated states, throughout the world, but wherever left to run wild has invariably assumed or preserved in every detail the specific or varietal characteristics (see pp. 98, 100, 102) even though grown for a century or more under divergent climatic and soil conditions to those of its original habitat. And this same story has to be repeated for most species, none more conspicuously so than *G. brasiliense*—kidney cotton. Both in India and Africa that plant is quite as frequently met with in a wild condition as in its ancestral home in Brazil. Wherever found the kidneyed condition of the seed

Specific characters.

is associated with peculiarities in stem, leaf and flower so invariable and constant as to defy separation into geographical races (see pp. 297, 306). There would seem but one satisfactory explanation applicable to such cases: namely, that the plants have reverted to or preserved their specific characteristics.

Seed selection.

To retain stock, therefore, at a required standard it becomes imperative to each year select from the field an individual plant, or a few individuals, that manifest the desired properties to the fullest extent. The seeds thus procured have next year to be raised in a plot of ground as distant and as much isolated as possible from the general plantation. On their nearing maturity all the individuals observed to manifest undesirable departures (from the accepted standard) have to be uprooted. The remaining plants now afford the seed for the following year's field cultivation.

Seed farms.

Year after year this selection, with a view to maintain a desired standard, may have to be continued, otherwise neither the standard nor the uniformity essential to success can be attained. The establishment of seed farms (see p. 175) in every country is now recognised as an imperative condition of improvement. Even after the expert hybridist has produced a desirable new stock it becomes essential that selection at seed farms should be conducted so as to ensure the adaptation of the new stock to each locality where its cultivation may be contemplated. In India years ago I drew attention to the danger that threatened the cotton industry of that country through the establishment of public steam gins in place of the private hand gins of former times. The destruction of the special selection of centuries became a natural consequence, since the owners of the steam gins would naturally return to the cultivators a supply of mixed seed, if not of seed utterly unsuited to their fields. At the first meeting of the Scientific Board of Advice in India I also recommended the establishment of special seed farms as the most pressing necessity of the cotton industry.

Effect of Steam gins.

Directions of Field selection.

But the process of simple (field) selection may be two-fold—the discovery of forms capable of gradual development and the preservation of others that suddenly appear in their perfect condition. Only very rarely, however, do either of these originate new stocks not directly traceable to hybrid influence. Every now and again we read, however, of individual plants having suddenly appeared that were observed to manifest some desirable new properties. The seeds of such plants having been carefully preserved and the process of

selection (above briefly indicated) subsequently conducted until the degree of fixity had been attained that justified their recognition as new stocks, with such and such properties. These are the opinions currently accepted by practical men.

Development.

Mr. Herbert J. Webber has devoted much special study to the science of cotton improvement by continuous and gradual selection. His results have already been briefly indicated (see pp. 282–3) in connection with Sea Island cotton, and need not be repeated here.

Standards.

The principles involved are (*a*) increased weight of wool (lint) to weight of seed: that is to say, the seed-cotton is weighed and subsequently the proportion of ginned lint afforded is ascertained and registered. An increase relatively of the yield of lint is a desirable criterion. But (*b*) it is necessary to test the yield to the acre. That is to say, the fibre to seed may be in a satisfactory proportion, but the number of pods produced per plant abnormally low. These two points satisfactorily established, the floss is next (*c*) tested as to uniformity (see p. 27, 34-36 and 49-51), and also as to length, fineness, strength, colour and softness (pp. 28, 41–44). Lastly (*d*) suitability to climate and soil (pp. 30, 38, 47–9), season of cultivation (pp. 29, 30–33), also liability or immunity to diseases or pests, has to be considered.

It will be seen from the illustrations already furnished under the headings of the species of plants, that expert cotton farmers have established a most useful method of expressing by figures the relative values of crops (see p. 283).

Sudden manifestations.

Perhaps no better example could be given of the value of selection and preservation of manifestations that appear suddenly as a method of stock improvement than the results attained in the production of disease-resistant forms. Mr. W. A. Orton reviewed the results achieved in a paper delivered before the Conference on Hybridisation of 1902. He there describes experiments carried out by the United States Department of Agriculture in the Southern States with the

Wilt.

fungal disease known as 'Cotton Wilt.' The parasite in question has been named *Neocosmospora vasinfecta*. It enters the tissue of the cotton plant through the roots and grows upwards, invading the region of the ascending sap and thus depriving the cotton of nourishment, and causing the withering up and death of the superficial structures.

Remedies.

The usual remedial measures, such as rotation of crops, the use of fertilisers, and the employment of fungicides, having all proved unavailing to check the disease, the discontinuance of cotton cultivation became almost inevitable in badly affected areas. Fortunately,

however, it was observed that in most fields a few plants were not affected by the disease, while the destruction was otherwise universal. Seed of such individual plants was saved and sown in rows between ordinary seed and on soil known to be badly infected. Any plants within the special rows that subsequently manifested the disease were uprooted. Seed was again preserved and similarly treated till it had been satisfactorily proved that a stock had been thus discovered that was to all intents and purposes Wilt-resistant. But an interesting fact has now to be added: namely, that in thus selecting for 'Wilt-resistance' it was observed that the special properties for which the plants had been previously grown were by no means lost, in fact in some cases they had been improved. But by far the most important fact demonstrated was that, in the case of the 'Sensation Sea Island Cotton,' even in the seventh generation, the Wilt-resistance was as marked as when originally discovered. Thus by simple selection of the fittest the complete victory of 'Wilt' had been attained.

Wilt-resistant stocks.

The explanation of this marvellous and highly satisfactory resistance of infection, thus manifested by individual plants, has not as yet been satisfactorily explained, but it appears to be physiological rather than mechanical. There are no structural manifestations as yet recorded by which a resistant plant can be recognised. Further, it may be reiterated that the fully resistant types mentioned appeared as isolated individuals and bred true at once. Selection toward the production or even the strengthening of the special property was not required. Resistance was fully established from the beginning. It was therefore a manifestation of the 'mutations' of De Vries, rather than of the 'slight variations' of Darwin.

There can be no possible doubt, however, that the systematic selection of stock for each individual plantation (or restricted area of plantations) is not only imperatively necessary, to preserve and maintain the quality of the stock, but is the chief method of improvement to the conditions of soil, climate and methods of cultivation, available to the ordinary cultivator. Nothing could be more disastrous than the use of seed promiscuously—that is to say, in utter disregard of both the plant and its environment.

Value of selection.

Hybridisation and Crossing of Stock.—Much difference of opinion exists among experts as to the value of this process of cotton improvement. Dr. Angelo Aliotta, in his 'Riv. Crit. del Genere Gossypium,' 1903, gives an elaborate statement of the races of cultivated cottons which he thinks have been produced through the

Hybridisation and evolution.

cross breeding of his five species—*G. barbadense*, *G. religiosum*, *G. arboreum*, *G. herbaceum*, and *G. hirsutum*. On the other hand, Mr. G. A. Gammie, Professor of Botany at Poona, Bombay, in his recent report ('The Indian Cottons,' 1905) reduces all the Indian cultivated forms to *G. obtusifolium*, and treats the still older species of Linnæus (*G. herbaceum* and *G. arboreum*) as only sub-species under the Roxburghian plant. (See p. 5.) He would, moreover, not appear to regard hybridisation as of any practical value whatever. Accordingly he observes that the so-called species and hybrids are merely cultivated races evolved by time and environment from one prototype.

After many years of careful study of the Indian cottons, both in the field and in the herbarium, I am constrained to join issue with Dr. Aliotta and writers of his school in thinking that the hybridisation of the species of *Gossypium*, as well as the crossing of its varieties and races, has played an important rôle, though I do not of course agree to the reduction of the ancestral stocks to five forms. Still I am satisfied that many of the more highly prized cultivated cottons are not species botanically, but races, perhaps rather natural hybrids (some of the more recent being artificial), adapted by selection to man's requirements and to environment. I am at one in fact with the army of workers in America, who not only say they have produced endless forms by crossing, but who regard that agency as of the greatest possible importance.

Tendencies.

Mr. S. M. Tracey, for example (in Dabney's 'The Cotton Plant' (1896), pp. 197–224), in dealing with the 'Cultivated Varieties,' remarks: 'Although the plants from a single line of crosses, as fertilising Peterkin with Allen, will vary widely, still it is a general rule that the character and habit of the future plant will be more like those of the female parent, while the fruit, the boll and its contents, will be more like those of the male parent.' So again, 'The tendency of the plant to vary from typical form of any variety will be back toward its original form rather than in any other direction.' From these and such like considerations is doubtless due the affirmation that, from one or two plants specially cultivated and as a consequence of careful selection, it might be possible to produce all the chief types of cultivated cottons. Hence it may be said that with few other cultivated plants is a more rigid selection of seed necessary than with cotton. Moreover, there seems little doubt but that historically it can be shown that *G. hirsutum*, *G. mexicanum*, *G. vitifolium* and *G. barbadense*, as manifested

Hybrid stocks.

to-day, are themselves to a large extent hybrid stocks. It does not follow, however, that all hybrids that can be produced will be fertile, still less that they can be invariably again further hybridised with fresh influences, according to the fancy of the operator. To the neglect of these considerations may in part be due the failures that have been recorded.

Natural or accidental hybrids.

In another place (see p. 193) I have shown that one of the systems, often pursued by cotton-growers in the United States, is to plant in close proximity two or more forms of cotton that they wish to hybridise, and to trust to insects and perhaps also birds to accomplish naturally the transference of the pollen. In this way several of the special stocks now in use have been produced. These may be characterised as accidental in contra-distinction to those produced by direct experiment, which might be spoken of as intentional hybrids and crosses.

Direct hybrids.

There are numerous records of direct or intentional hybridisation.

Rohr's investigations.

Perhaps the first person who investigated the possibility of improving the quality and quantity of cotton by means of hybridisation was the Danish colonist Rohr, who resided for some years in Sainte Croix (Santa Cruz). About 1786–1790 he was engaged on a special inquiry, and published his wonderfully interesting little book ('Observ. sur la Cult. du Coton'—German edition 1790, French 1807') which gives the results of his investigations and experiences as a cotton planter. After describing some 30 species and cultivated races, he devotes a considerable portion of his work to the methods he pursued in selection and hybridisation of stock. He urges again and again for purity and uniformity in the plantation. (See pp. 200, 262–4.)

Fuzzy seed and naked seed.

Rohr had observed that fecundation ordinarily takes place in *Gossypium* before the flower has fully expanded. He had noted that certain plants gave a fine silky cotton but scanty as to quantity, while others yielded a large amount of coarse woolly floss. He accordingly gave a hypothetical case of improvement when he suggested the crossing of two such plants as his 'Curaçao' (Curaçao Island) (*G. punctatum, var. jamaica*, cf. p. 170, 172) with 'Carthagena cotton' (a form doubtless of *G. barbadense*.) He does not say that he had actually produced such a hybrid, but speaks of it as an ordinary every-day cross that anyone could accomplish. The stamens from an unopened flower of Curaçao should be removed, he says, and its pistil at once impregnated with the anthers taken from a similar flower of Carthagena cotton. This would be a cross between a fuzzy-seeded

and a naked-seeded cotton, and it may be surmised might produce a plant very much like *G. peruvianum*, see pp. 165–6, 190, 213, 219, &c. But Rohr next gives us particulars of an actual cross that he had accomplished and used. He fecundated the flowers of his 'Indian cotton' (*G. purpurascens*, as I take it, p. 254) with the pollen of 'Brazilian cotton' (*G. brasiliense*). As the result he obtained a new stock of great value, the branches of which were not so straggling as in the Indian and even more compact than in the Brazilian ancestor. It was also a fortunate circumstance that the offspring were found to mature earlier than either parent—a property that we can imagine may have gradually led to the production of an annual stock. The leaves of the hybrid resembled mostly those of the Brazilian cotton. Rohr does not tell us whether the seeds were free as in the Indian or united as in the Brazilian.

Two naked-seeded cottons crossed.

But it perhaps may be admitted that we have in Rohr's hybrid (Indian × Brazilian) the first conception of the great 'Sea Island Cotton,' itself a hybrid, as I suspect, between *G. barbadense* (or *G. vitifolium*) and *G. brasiliense* (see p. 287).

First conception of Sea Island.

There may be some uncertainty as to Rohr's Indian cotton. It had a smooth brown-black seed distinctly veined and with only an imperfect tuft of velvet on one side of the beak. He saw it originally in the garden of a highly intelligent native of Colombia between Saint Martin and Carthagena). The wool was pure white, very fine and silky, not easily soiled, but such that it could be readily separated from the seed. The leaves were constantly 'convex'—a description that perhaps had reference to the form and position of the lobes. Lastly, the branches were long and straggling. The cotton that answers best to these particulars is undoubtedly *G. purpurascens*—Bourbon cotton (see p. 250–5).

I have repeated these particulars from Rohr's account of his Curaçao cotton to enable an opinion being formed as to the so-called 'Indian cotton.' It might, of course, be one of the forms of *G. vitifolium*, but I think it is more than likely to have been *G. purpurascens*, which there seems little occasion to doubt was evolved from *G. taitense*. We can, however, be quite certain regarding the Brazilian cotton grown by Rohr and used in hybridisation—it was *G. brasiliense*. It is thus significant that 120 years ago Rohr was investigating and hybridising the cottons at his plantation by methods that compare favourably with the most advanced conceptions on that subject at the present day.

For fully half a century South America and the Antilles did a large trade in supplying Brazilian cotton. There were, in fact, two chief grades of cotton then known in the markets of Europe, viz. Levantine and Brazilian.

Stock improved in West Indies.

The picture Rohr gives us of a West Indian plantation is most instructive; it would consist chiefly of Guiana and Brazil cottons—both of them forms of *G. brasiliense*—intermixed with several forms of *G. barbadense* (the most prevalent being that called 'Year round,' and lastly several distinct races of *G. purpurascens*—Bourbon cotton (see pp. 254, 263). But the early planters of the West Indies set before themselves the task of improving both the quality and the yield of their cottons, and there seems little doubt made immense progress only to abandon further effort through the greater popularity of sugar-planting. It is thus permissible to assume that, before cotton cultivation was displaced by sugar, the great Sea Island cotton stock had been evolved in the West Indies, and that most probably it is a hybrid between *G. barbadense* (*G. vitifolium*) and *G. brasiliense*. In a further passage (p. 346) it will be seen this view is apparently upheld by an inspection of the pollen grains.

Indian experiments.

As an historic fact in Indian hybridisation it may be mentioned that in 1844 Mr. Alex. Burns of Broach crossed *G. obtusifolium var. Wightiana* with *G. arboreum*. He obtained a plant that had all the good points of both parents. The leaves were those of *arboreum*, only larger and more hairy, and the flowers were red with a yellow ring in the throat. This interesting new form, apparently a first generation hybrid, blossomed and thereafter yielded its crop within the space of two months, much as in Broach *deshi*, and the floss was very silky. The Bombay Chamber of Commerce expressed the opinion that the cross was an exceedingly valuable one. No further information was, however, published regarding it, and the plant seems to have died out. The circumstance is mentioned to show that crosses are possible. (For further particulars see p. 89.)

There would seem, moreover, little doubt that the cotton designated by Rohr as Porto Rico is the plant accepted by me as *G. microcarpum, Tod.* Rohr (*l. c.* pp. 11, 64–6) describes it as hairy, the seeds covered all over with down, and so pressed together that they form a pyramidal mass. I have shown elsewhere (p. 213) that this particular plant is met with only under cultivation, and in all probability is a hybrid produced very possibly from *G. brasiliense* or *G. barbadense*, with *G. Schottii*, or some other member of the special

group of American cottons with fuzzy seeds and free bracteoles. And I therefore desire to repeat that there would seem every ground for supposing that that imperfectly known group of fuzzy-seeded cottons may have exercised a great influence on many of the fuzzy-seeded cultivated cottons of the New World (see pp. 166–7).

Trevor Clarke's experiments.

The next series of direct experiments in cotton hybridisation that need be mentioned was conducted nearly a century later than Rohr's investigations (in other words some 35 years ago) by Major Trevor Clarke of Welton Place, Daventry, England. Burbidge ('Propag. and Improv. of Cult. Pl.', p. 388) alludes very briefly to Clarke's opinions and experiments without suggesting verification as being likely to be necessary. And yet in certain directions Clarke's conclusions are distinctly conjectural, if not questionable. He, for example, arrived at an emphatic opinion, namely, that it was not possible to cross the cottons of the Old World with those of the New, but that all the species of either hemisphere might be crossed among themselves. That opinion became universally accepted, and for many years restrained, if it did not check, the experiments that might otherwise, and with great advantage, have been conducted. (See pp. 111, 113, 133–4, 165 and 190.)

The results obtained by Clarke were communicated to Mr. H. Rivett-Carnac, then Cotton Commissioner of India, and his cross-bred stocks were supplied to the Indian Department for experimental cultivation. He tells us for example of having crossed the 'Assam Hill Cotton' with Hinganghat and sent the seed to Nagpur and Akola for cultivation (see p. 113). So again he says, 'My most interesting cross, viz. Hinganghat by *G. arboreum* (*i.e. nurmah*), is thriving and will soon flower, showing that it has secured the early flowering habit of the Hinganghat parent; of it I send you one or two seeds. I had only one small boll come to perfection.' So also he experimented apparently with *wagria* cotton, which he describes as 'the broad-leaved type in the close pods and strong bulky staple. I hope this will produce sorts with more expanded pods and finer staple combined with length.' In another place (p. 152) I have suggested that the *wagria* cotton of Gujarat is itself a hybrid of *deshi* Broach and *bani*. I had made that suggestion before reading the above passage in Major Trevor Clarke's report. So again Clarke observes, 'The only Indian cottons that at all come up to the bulky properties of the Uplands, according to my experience, are produced by the breed of which the bolls are dumpy

Wagria cotton.

and cob-nut-shaped, and only half opening when ripe. Dholera and Western Madras, as supplied to me, are of this kind. Now a cross between a high-class plant of this form and a good Hinganghat would be a great step.'

Bani as a hybridising stock.

There is perhaps no feature of Major Trevor Clarke's experiments that would seem to demand more careful consideration than the urgency of his recommendation for Hinganghat cotton being accepted as one of the elements in hybrid stocks—that is to say, the plant that I have designated as *G. Nanking, var. Bani* (pp. 131–4). In one passage, for example, he observes, 'Any of the larger and coarser Indian sorts would give size and vigour to Hinganghat, but with little abstraction of its silky qualities. I have proved this and enclose samples in illustration. What I mean by *nurmah* is your wild red-blossomed shrubby cotton. The hybrid is earlier to blossom and prolific; staple almost identical with Hinganghat as to length, as both parents are alike in this particular. I enclose samples of such Hinganghat crosses as I have fruited myself. They are great successes here.'

Clarke's experiments with American cotton.

In other instances Major Trevor Clarke deals with his experiments with the American cottons. He speaks of having crossed Sea Island with New Orleans; of New Orleans by the hybrid Georgian. He refers to the Pernambuco as the hardiest sort met with, although it yields a short staple. Because of its hardiness it was deemed as a specially valuable stock to experiment with. He crossed 'Vine cotton' with Sea Island, and found the hybrid a late bearer but the cotton magnificent. He refers to the fact of Bourbon having been long successfully grown in India, and accordingly suggests its hybridisation with Sea Island as worthy of being attempted. Its fibre, he adds 'is the finest (in tenuity) I ever saw.'

Elements of failure.

These passages briefly indicate the extent and value of Major Trevor Clarke's experiments, and it is disappointing that two circumstances should have combined to obscure and finally obliterate them entirely from public attention: *first*, the immense prosperity of the American supply rendered other fields of comparatively little interest; and *second* the false conception that the American results might be engrafted on to all other countries by acclimatisation without the labour and expense of direct production from local stocks.

The neglect to develop local stocks cannot, however, be placed to Major Trevor Clarke's account, for he recommended the Indian Cotton Commissioner 'to begin with cross-breeding by yourselves.

I should recommend your turning your attention principally to the crossing of your native sorts with each other.' He then adds, a most significant sentence, and one that shows the care with which he prosecuted his investigations. 'According to my long experience, the produce of *any* two varieties of fair qualities is more *vigorous* and often generally better than either parent.' It is an accepted axiom to-day that crossing almost invariably increases vigour, but was that opinion at all general nearly forty years ago, when Major Trevor Clarke was obtaining his knowledge and experience of the cotton plants? (see p. 153).

Strength of hybrids.

But to conclude this notice of Clarke and his cotton experiments, it may be said that he recommended that the pollen should be applied over-night, '*i.e.* just before the flower has expanded or has been attacked by pollen-bearing insects.' Lastly he adds, 'I strongly doubt the possibility of any cross between exotic and Indian sorts, and fear you will be disappointed in this respect when your plants come to perfection.' This, as it would seem, was an unfortunate opinion, since there can be no doubt that such hybrids, while sometimes difficult to produce, actually can be and have been formed. The negative pronouncement by a recognised authority has doubtless retarded many practical and useful experiments that might have been conducted by other investigators.

Indigenous × exotic.

It seems, however, that Major Trevor Clarke, and others who accepted his views on the crossing of Asiatic and American cottons, proceeded very largely from imperfect knowledge of the genus (see pp. 165 and 190). The *G. herbaceum* of most early writers, regarding the southern of the United States of America, was doubtless *G. punctatum, var. jamaica*, but of the northern portions of the cotton belt it was the true *G. herbaceum* introduced in the early decades of the eighteenth century. In both localities hybridisation actually did take place. A movement from the northern into the south and south-western tracts was a consequence of the greater suitability of the warmer regions. It was of necessity accompanied with an abandonment of much of the early stock, so that while *G. herbaceum* hybrids undoubtedly do exist in the United States they are less abundant than those traceable to *G. punctatum*. But the point of importance here urged is that hybrids of *G. herbaceum*, a so-called Old World form, were actually accomplished and the other element of that stock was an undoubted New World species. So also in South India there exist several undoubted hybrids such as the

Imperfect knowledge.

tellapatti (often called the black-seeded *jowari hathi*) which can best be accounted for by the belief that it is a naturally produced hybrid between *uppam* and Bourbon cotton (see pp. 152–3). In the remarks that follow regarding the pollen-grains of hybrid cottons, it will be seen that Professor Gammie of Poona, India, states that he had actually produced hybrids between *G. hirsutum* and one of the many forms of *G. obtusifolium* (D × K hybrid No. 2) also between *G. hirsutum* and *G. roseum* (V × D hybrid No. 3), thus proving that hybrids between the so-called Asiatic and American cottons are not only possible but actually exist (see remarks pp. 111–14). The account (pp. 181–2) of Mr. Lawrence Ball's experiments at crossing *G. barbadense* with *G. punctatum*, and the particulars afforded (pp. 194, 234–5) regarding the production of the Long Staple Uplands are also of the same nature.

Hybrids of Asiatic × American stocks.

Fertility of hybrids.

But, as already admitted, there would seem to be no doubt that certain New World forms are difficult to hybridise with Old World species. May not the explanation, however, be that they are themselves hybrids which in some instances might be expected to resist further direct crossing? Moreover, it has been pointed out (Section I. p. 62) that the genus *Gossypium* embraces several species that probably may have to be transferred to other genera. It is well known that many genera often have had species assigned to them so remote from each other that they are often not capable of direct hybridisation. And in the case of *Gossypium*, at all events, there would almost appear to be occasional or accidental conditions that favour hybridisation which, when not present, have given the impression that crossing was impossible. In another place (p. 286) I have incidentally alluded to some of the results obtained by Mr. W. Austin Cannon in the hybridisation of cotton. His special studies on 'The Spermatogenesis of Hybrid Cotton' ('Bull. Torrey Bot. Club,' vol. 30, 1903, pp. 133–72, Plates 7 and 8) will be found of exceptional interest and value. He not only gives a historic sketch of hybridisation but shows the special bearing of that science on cotton production. His address to the New York Hybrid Conference of 1902 on some 'Cytological Aspects of Hybrids,' forces attention on the question of the relationship between cytological studies and the experimental work of the hybridist. Mr. Cannon believes that (*a*) the normal divisions of the male nuclei lead to fertility while the abnormal divisions conduce toward sterility. And (*b*) that the variation of hybrids may or may not be associated with variation in

Spermatogenesis.

Cytological research.

spermatogenesis. Lastly, that in certain cases the chromosomes derived from the parent tend to preserve their individuality. Mr. Cannon then recommends that in the future cytological work should be performed with species that give marked experimental results.

Before workable theories can be formulated, therefore, the pure species and varieties of *Gossypium* must be subjected to a searching practical inquiry by carefully conducted experiments such as those indicated by Cannon and conducted, too, under every likely condition calculated to favour or retard hybridisation. The story of the crossing of other plants (such as sweet peas) shows that there are often special conditions (perhaps but occasionally present) that favour crosses being accomplished. This whole subject is accordingly pregnant with meaning not only to the scientific but to the practical inquirer. I am strongly disposed to suspect accordingly that some of the species placed in Section I. above, may have to be carried to other genera. The majority will remain, however, as a perfectly natural assemblage of wild *Gossypia* that have not contributed in the past, nor are they likely in the future to do so materially towards the production of commercial cottons. It is also curious, as presently to be shown in the remarks below under pollen-grains, that certain groups of species in *Gossypium* approximate to the conditions of grains found to prevail in all four tribes of Malvaceæ. This is most disconcerting, but it is just possible that crossing the species that possess similar pollen-grains may be found easier than between the groups possessed of dissimilar grains. I mention these facts here as showing that within the genus there are doubtless forms that may not be found capable of immediate hybridisation in every desired direction.

Special conditions that favour hybridisation.

Wild cottons.

But belief in the value of hybridisation might be exemplified by any and every group of cultivated plants. Perhaps no more remarkable case could, however, be mentioned than the splendid results attained with sugar-cane, by Sir Daniel Morris and his staff of expert scientific investigators, of the Imperial Department of Agriculture, in the West Indies. The fact that the sugar-cane actually did produce fertile seeds was not known to botanical science much before 1887. In that year Dr. Benecke published the results of researches conducted in Java into the possible improvement of sugar-cane and the production of blight-resistant stocks derived from seedlings. About the same time Professor J. B. Harrison and Mr. T. R. Bovell of the Botanical Station, Barbados, drew attention to the seedlings that they had raised and the highly instructive

Sugar-cane hybrids.

experiments they had conducted in the West Indies. These discoveries were appreciatively reviewed in the Linnean Society's Journal (1891) by the then Assistant Director of Kew, Mr. (now Sir) Daniel Morris. Some few years later, Sir Daniel having been appointed Imperial Commissioner of Agriculture in the West Indies, turned his attention energetically to the endeavour to improve stock through raising and perfecting the properties of seedling canes. And from this position the subject was naturally advanced to that of the benefits derivable by cross hybridisation of the forms found to produce fertile stamens and pistils. As a consequence it might be affirmed that the hybrids or crosses that now exist hardly date further back than a decade or so, and their histories are, therefore, fairly well known. It was observed that some flowering canes produced numerous fertile stamens but hardly any fertile pistils, while others had many pistils but hardly any stamens. The direct pollination of the pistils became thus an obvious method of obtaining a large supply of seedlings, and the crossing of the merits of different stocks thus naturally presented itself as an important feature of all such experiments. It is accordingly customary nowadays to read of the sale of 'pedigree canes.'

Pedigree canes.

If such magnificent results can be and have been attained in a few years with a plant that flowers but rarely, and even still more rarely produces fertile seeds, how very much more should it be possible with cotton—a plant that through the early maturity of its stamens (as in Mendel's classic experiments with *Pisum sativum*), is fully under control, and with delicate manipulation can be readily and accurately fertilised in any desired direction.

Obviously, therefore, a method of ascertaining expeditiously when hybridisation had been accomplished (or had previously existed) would effect an infinite economy in the production of new forms. The system that at present prevails with cotton planters (already fully detailed) is to select desirable forms that have appeared spontaneously. These are called 'seminal sports' or simply 'sports' or 'climatic varieties' and writers who use such terms often speak with scorn of the possibility of improvement through direct and definite fertilisation. A little more study might, however, reveal the fact that the majority of such manifestations may be either naturally formed hybrids or the progeny of hybrids—recessive types in some cases—and that many of them might, if so desired, be definitely produced, and even fixed in half the time usually spent in

Economy in production.

'field selection,' were their production attempted by systematic hybridisation in place of the present method of accidental elimination.

Union of similar gametes.

This view might be exemplified again and again. Mr. W. Bateson for example (see his address at the New York Hybrid Conference), made the significant observation, 'We have lost for ever, I think, the conception that fixity of character is solely or chiefly a function of the number of generations during which that character has been manifested, or of the number of successive selections of that particular variety which has been made.'

'Purity of strain, or fixity of character, is, on the contrary, due primarily to the union of similar gametes in fertilisation.' Conversely when dissimilar gametes are crossed the resultant is the reappearance of an ancient form (see pp. 111, 134).

Ascertainment of stability.

It is thus obvious that 'field selection' may often be a useless expenditure of time and money, a process of groping in the dark, due to being concentrated more frequently on unstable than stable objects. The failures are infinite and soon forgotten, the successes are few, but instantly seized upon and preserved. It is imperative that the first principle in selection should be the ascertainment of stability. Accurate knowledge of the species or variety, as recognised by botanists, is in many instances at least the first and most important step in that direction. But the study involved may call forth investigations ordinarily deemed beyond the sphere of the systematist. The colour of the flower, the degree of segmentation of the leaves, the union of the bracteoles, the length, colour and texture of the floss, or the shape and size of the pollen-grains, may each

Purity of strain.

and all afford characters by which to test the purity or otherwise of the strain present in the plant under observation and experiment. Characters which in systematic botany might be regarded as too trivial for consideration may accordingly assume importance in this special study. It is on this account that I have been induced to place value on certain observations made into the condition of the

Pollen-grains.

pollen-grains. But while most anxious to avoid raising false expectations, it would seem to me that the pollen-grains may sometimes afford useful hints as to the hybridisation that has been accomplished, or which may be accepted as actually existing in desirable and useful stocks. With that object in view I venture to set forth some of my studies, though fully conscious that more extended investigations will be necessary before these can be definitely accepted.

Pollen-grains as a Possible Aid in the Study of Hybrids.—I am greatly indebted to my friend Mr. J. S. Slater for having devoted much time and attention to the study of the pollen-grains of this genus. Mr. Slater informs me that he commenced the study of pollen-grains with a view to ascertain whether any light could thereby be thrown on the origin of hybrids. A selection of the more characteristic species of *Gossypium*, each drawn from two or three independent and often remote localities, having been furnished by me, the pollen-grains of these (taken from flower-buds as far as found possible, in order to avoid contamination), were carefully mounted in the form of microscopic slides and then critically and comparatively examined. The grains shown on each slide were derived from but one anther, or at all events from the selfsame andrœcium. Every precaution was thus observed to ensure accuracy, not an easy matter when working with dried herbarium specimens that have often to be boiled before they can be examined at all. The method of examination pursued may be said to have been as follows:—When buds were obtainable they were boiled in water so as to facilitate the removal of the pollen-grains. When flowers only were available a few anthers were removed, and from these the grains were derived by cutting open in a drop of 10 per cent. solution of chloral hydrate. The moisture was thereafter removed by absorption. The grains were then stained in 'Bismarck-braun' and finally cleared in absolute alcohol and mounted in Canada balsam and xylol. Uniformity in treatment having been thus observed, the results may be regarded as relatively correct. In Mr. Slater's opinion boiling or non-boiling does not affect the shape or size of cotton pollen-grains.

Source of grains.

Method of examination.

Mr. Slater was good enough to place in my hands an extensive series of these microscopic slides, as also to furnish micro-photographs, some magnified 450 and others 300 times life-size. I have had reproduced a few of these photographs, on **Plates Nos. 52 and 53**, but the selection has been governed by the desire to exemplify the more striking peculiarities observed, rather than to expound any theories that might be advanced regarding their structural peculiarities. The results of this special and comparative study of the pollen-grains of a large percentage of the species, varieties and races of *Gossypium*, so far as it has gone, would seem, however, sufficiently suggestive to warrant the main ideas being here indicated, even although it would be premature to lay down definite conclusions. The remarks that follow must accordingly be accepted as purely

Micro-photographs.

tentative, and as given with the express object of inviting more extended inquiry, especially on the part of investigators who may have the opportunity of studying the pollen-grains of living plants.

Homology of the grain.

The pollen-grain, through its close homology, is often spoken of as a spore (microspore), derived from a sporogenous mother-cell and sporangium—the anther. It is at first a nucleated spore that becomes possessed in time of two portions—a vegetative and a generative. If placed on a drop of sweet fluid, the grain (spore) germinates, and through its tube the protoplasm of the generative cell, with one of its nuclei, passes into the egg-cell (oosphere) of the ovule, thus causing fertilisation. This then is the modern conception of the pollen-grain, and one that it is necessary to bear in mind, in the study of these grains or spores, when prompted with a view to discover methods of improvement of stock.

Structure of the grain.

The pollen-grains in *Gossypium* are, when fully grown, spheroid in shape and, as with those of most other plants, may be spoken of as possessing two coats or walls: an outer and thicker coat, the *exine* (or, as it is sometimes written, the *extine*), and an inner thinner and often transparent wall, the *intine*. These enclose, as the spore contents, a thickened granular fluid. Under the influence of moisture the inner coat would appear to swell more rapidly than the outer, and at certain points thickens into hemispheric patches which commence to press against the inner surface of the exine until they ultimately penetrate through it.

Many tubes.

The species of *Gossypium* all agree in possessing numerous points of emergence, hence in forming many tubes. According to some writers pollen-grains have definite pores, specially contrived to facilitate the passage of the germinating and elongating pollen tubes; by others these are merely thinner portions of the exine that become dilated and finally ruptured by the vigorously growing tubes. As seen under the microscope there would seem to be four main types of cotton pollen-grains:—

Chief types of cotton grains:

(*a*) Those in which the exine is greatly thickened and covered by prominent warts, the bases of which are striated or buttressed, or appear in certain attitudes like the teeth of a comb. On the summits of these warts often arise variously shaped hyaline spines. Between the spinose-warts are interspaces which seem closed in below by the thin inner layer of the exine. The interspaces are, in these *Gossypia* the pores or passages through which the pollen tubes emerge. This condition is best seen in *G. punctatum* **(see Plate 53, f. 16)**, in

G. barbadense, variety Sea Island (**see 53, f. 11**), and in *G. peruvianum* (**see 53, f. 20**) and is met with also in *Althæa*. But there are many modifications of it, or rather degrees of participation in the formations indicated. In *G. arboreum* the warts are small but numerous, compact, distinctly striated, opaque, and the surface of the spore conspicuously granular. **(Plate 52, ff. 7 and 10.)** In some species, on the other hand—as, for example, *G. hirsutum* and most of the Upland Cottons—the warts are often very obscure, or at least their striations (and buttressings) are so, if indeed these structures might not be described as entirely absent. **(See Plates 52, f. 6, and 53, f. 13.)**

Buttressed condition.

(*b*) The second chief condition is that in which warts and sometimes also spines are nearly or entirely absent. The latter, according to some observers, are caducous, and the exine is then seen to consist of a uniform compact layer that, as Schacht observes, recalls a palisade structure. Mr. Slater, however, seems to be doubtful whether the spines are ever caducous, and in support of this opinion mentions the circumstance that although he has examined many hundred specimens of *Gossypium* he has never observed a detached spine. The present condition is strikingly seen in *G. drynarioides* **(Plate 52, f. 1)**, where the palisade layer is very thick—a condition that would appear to be almost generic in *Pavonia*. In many of the races attributed to *G. Nanking* **(Plate 53, f. 14,** and in *G. Palmerii*, **Plate 53, f. 17)** a remarkably thin palisade layer occurs which is also prevalent in *Adansonia* and *Thurberia* (cf. p. 53, 63). In the *roji* cotton of Gujarat an almost intermediate condition exists **(Plate 53, f. 12)** in which a palisading layer appears like a union of the buttressings of the spines.

Palisade condition.

(*c*) A third condition is that in which both intine and exine are distinct and hyaline, no trace of striation or palisading is visible, and the long sub-linear spines seem as if they passed through the exine. This is well seen in *G. Sturtii* **(Plate 52, f. 2)**; in *G. Darwinii* **(f. 3)**; and to some extent is simulated in *roji* cotton **(Plate 53, f. 12)**.

Hyaline-linear spine condition.

(*d*) A fourth condition is that in which the warts are numerous, opaque, trapezoid in shape, suddenly tipped by long sharply pointed spines. This occurs in *G. Stocksii* **(Plate 52, f. 4)**; in *G. obtusifolium* **(ff. 8 and 9, also in Plate 53, f. 15)**; in *G. Kirkii* **(Plate 53, f. 21)**; is to all intents and purposes the condition that is met with in *G. brasiliense* **(Plate 53, f. 18)**; and lastly seems the generic peculiarity of the pollen-grains in *Cienfuegosia*.

Opaque-trapezoid wart condition.

Thus the thickness, shape and size of the sculpturings or surface

appendages of the exine would seem to afford characters by which it is fairly easy to isolate some at least of the various forms of cotton grains. It is difficult to find precise terms to indicate these peculiarities that would not be likely to convey false meanings, from their strict usages being with cellular and vascular tissues.

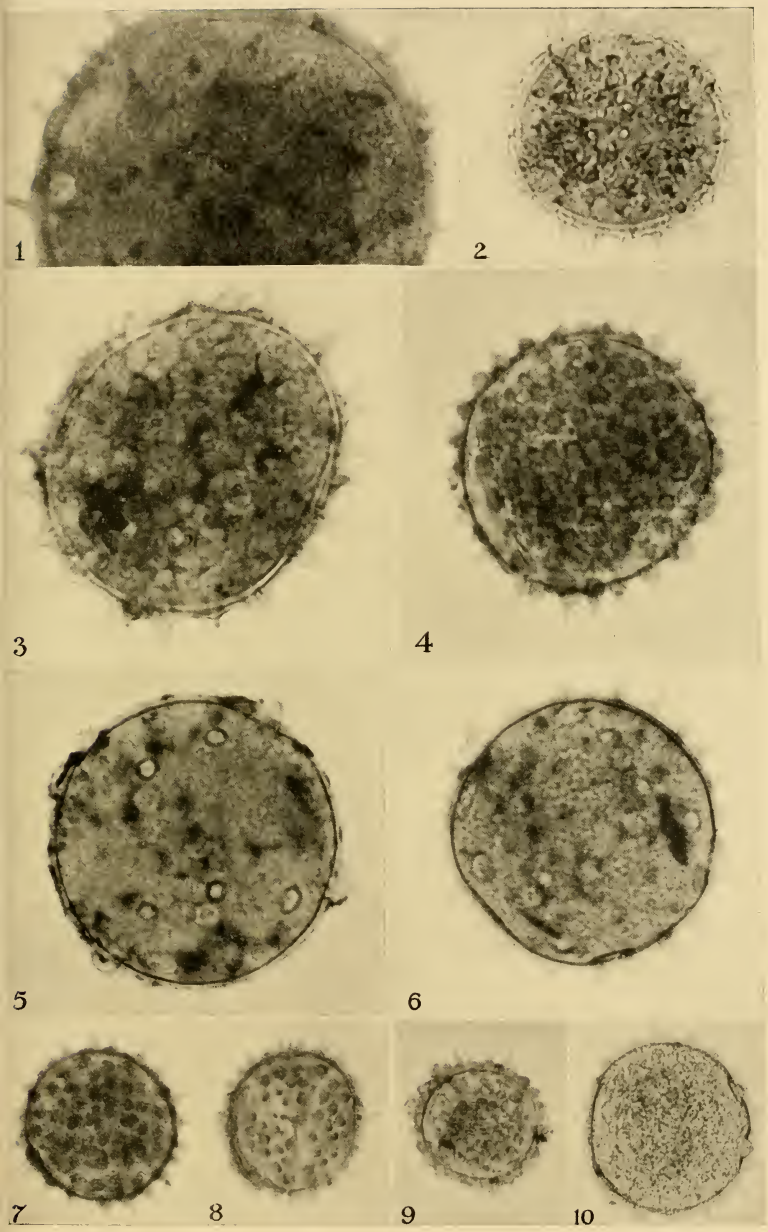
It would, however, from the circumstances mentioned, seem fairly certain that the characteristics of the pollen-grains in *Gossypia* are not generic. In fact they are representative of the pollen-grains seen in all four tribes of MALVACEÆ—viz. *Malveæ*, *Ureneæ*, *Hibisceæ* and *Bombaceæ*. This I do not venture to account for at present. So many distinctive forms are, in fact, present, that it would be more nearly correct to regard them as affording specific distinctions. But what is perhaps the most startling circumstance of all has now to be mentioned: namely, that in many instances more than one form and size of grain is present in one and the same androecium. The suspicion that these might be stages in the growth or age of the grains may perhaps be viewed as instantly dispelled by their constancy alike in young buds and fully developed flowers, as also by their reappearance in the self-same plant wherever met with or under whatever environment produced.

Different grains often seen in same anther.

In all the artificially formed hybrids examined by me, two or more forms of pollen-grains were invariably found present, as, for example, in the hybrids produced by Professor Gammie at Poona. In his *goghari* × *varadi* three spores were found (**see Plate 53, ff. 13, 14, 15**). Of these three spores, **f. 15** is almost exactly that seen in the wild states of *G. obtusifolium*; **f. 14** would appear to have come from *G. Nanking*; and **f. 13** brings to mind *G. hirsutum* (**see 52, f. 6**) (cf. p. 111). I have not attempted to ascertain the relative proportions of each form present, but doubtless that aspect should command consideration.

Hybrids indicated by pollen-grains.

Since *G. hirsutum* is in India extensively cultivated, mixed with the purely Indian stocks, the appearance of this spore might be, perhaps, viewed as not unnatural. So again in the chief cultivated races of cotton, accepted by me from other evidence as most probably being hybrids, two spores are in almost every instance present. For example in the Upland cottons two spores are invariable (**see Plate 52, ff. 5 and 6**). Similarly Sea Island has also two spores (**see Plate 53, f. 11 and f. 18,** and conf. with pp. 287, 315, 335), and *G. peruvianum* (**Plate 53, f. 20**) has also two spores, the one shown and the other that of *G. brasiliense* (**f. 18**). It would thus seem likely



No. 52. CHARACTERISTIC POLLEN GRAINS OF WILD AND CULTIVATED SPECIES OF GOSSYPIUM.

1. *G. drynarioides* × 450 times life size; 2. *G. Sturtii* × 450; 3. *G. Darwinii* × 450; 4. *G. Stocksii* × 450; 5. *G. hirsutum* × *mexicanum* (Molango) × 450; 6. *G. hirsutum* × *mexicanum* (Molango), second spore × 450; 7. *G. arboreum* × 300; 8. *G. obtusifolium* × 300; 9. *G. obtusifolium*, *var. africana* (*obtusifolium*, spore × 200); 10. Second (*arboreum*, spore × 300).

that if these observations be confirmed by more detailed investigations the view I have elsewhere advanced of Sea Island being a hybrid between *G. vitifolium* (or perhaps even still earlier, *G. punctatum*) and *G. brasiliense* may be universally accepted (see pp. 305–6).

Value of pollen-grains.

In making these observations on pollen-grains I have perhaps gone as far as my studies warrant at present. I am, however, constrained to believe that botanists may have erred, by going to the opposite extreme: namely, in believing that the characters of the pollen-grains are invariably generic, if not ordinal in value, and cannot therefore be utilised in separating species, if not groups of species, within certain genera.

The following explanatory notes on the two plates here given to exemplify the pollen-grains seen in *Gossypium* may be helpful, though I again desire to repeat that it is not intended these illustrations should be regarded as more than suggestive of further inquiry :—

PLATE No. 52.

Fig. 1. Shows the pollen-grain of *G. drynarioides* magnified 450 diameters. It, as also all the others given, can therefore be readily measured for actual size. (Cf. p. 71.)

Fig. 2. The pollen-grain seen in *G. Sturtii* × 450 (p. 63).

Fig. 3. The pollen-grain of *G. Darwinii* × 450 (p. 68).

Fig. 4. The grain seen in *G. Stocksii* × 450 (p. 73).

Figs. 5 and 6. Two forms of grain met with in the Molango state of Upland Cotton (*G. hirsutum* × *mexicanum*) × 450 (p. 231).

Fig. 7. The pollen-grain seen in *G. arboreum* × 300 (p. 81).

Fig. 8. The form characteristic of *G. obtusifolium* (wild state) × 300 (p. 139).

Figs. 9 and 10. Spores seen in *G. obtusifolium, var. africana*, × 300 (p. 153). The former belongs to the *G. obtusifolium* type and the latter to the *G. arboreum* × 300.

PLATE No. 53.

Fig. 11. The spore most abundant in *G. barbadense, var. maritima* (Sea Island cotton), × 450 (cf. p. 275). Its associated spore is identical with that shown on f. 18.

Fig. 12. The spore that seems to be characteristic of *roji* cotton × 450, and looks as if it might be spoken of as a Mosaic hybrid spore (p. 134).

Figs. 13, 14, and 15. Three conditions of pollen-grains found in an artificially produced hybrid made by Professor Gammie at Poona—*goghari* × *varadi* × 450 (pp. 111–2, 134). The first (13) closely matches No. 6, one of the spores of Molango cotton; 14 brings to mind the grain seen in many forms of *G. Nanking*; while 15 matches **f. 9**, seen in *G. obtusifolium* in Africa and also **f. 8**, *G. obtusifolium*, the wild state found in Kathiawar.

Fig. 16 is the spore found in *G. punctatum, var. jamaica*, × 300 (p. 170).

Fig. 17. The pollen-grains of *G. Palmerii* × 300 (p. 204). This spore is seen in many of the Upland cottons such as **ff. 6, 13.**

Fig. 18. This shows the pollen-grain found in all the wild or acclimatised forms of *G. brasiliense* × 450 (p. 295). It is also the alternative grain met with in the Sea Islands, Peruvian, &c.

Fig. 19. The spore most general in *G. taitense*, was taken from Deplanche's specimen n. 417 (p. 248).

Fig. 20. The spore of *G. peruvianum*, taken from G. F. im Thurn's n. 79 (pp. 213, 216). The alternative grain being **f. 18.**

Fig. 21. The pollen-grain of *G. Kirkii*, a somewhat remarkable form with long sharp spines deflected to one side (p. 316).

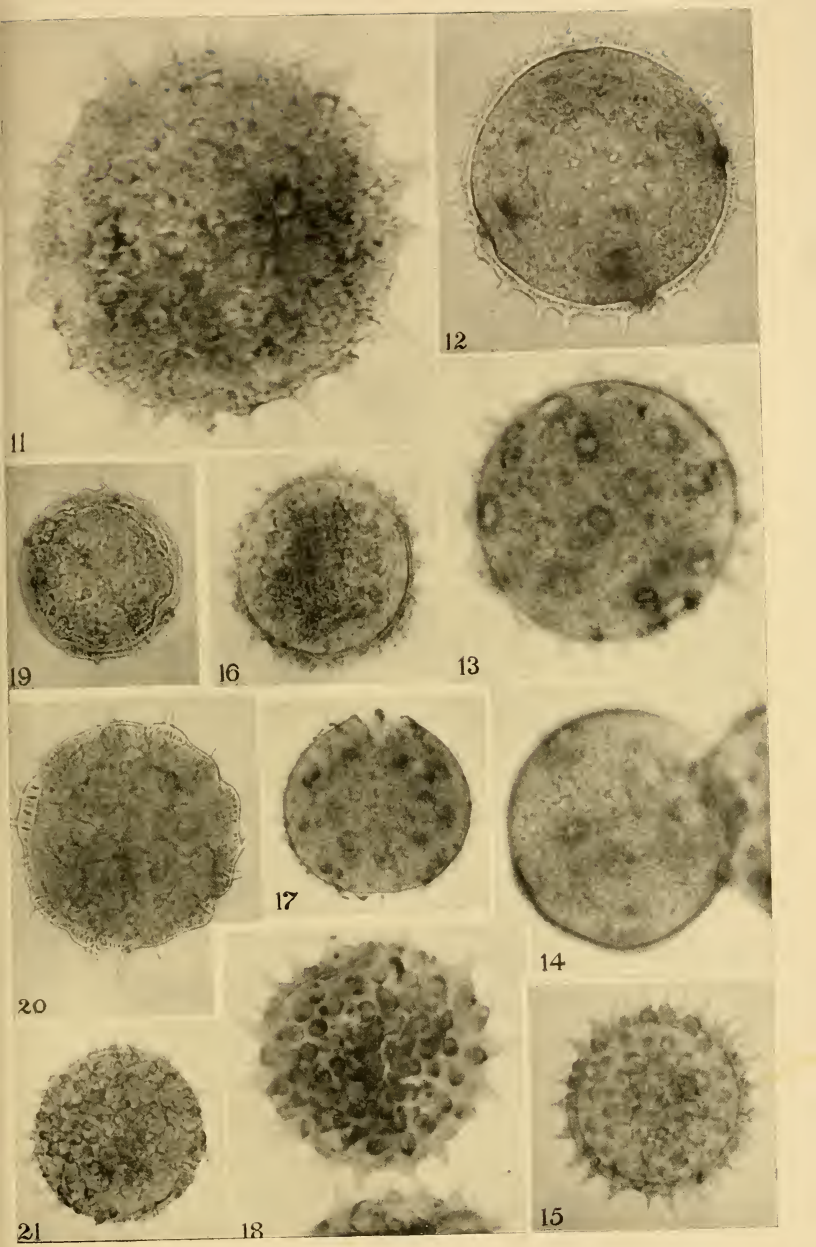
Biblio-graphy.

Bibliography of Pollen-grains in Malvaceæ.—It may be useful to bring together in this place a few passages from authors who have described the pollen-grains seen in Malvaceæ, more especially *Gossypium*. While doing so it may be possible to exhibit opinions that have a bearing on the suggestions advanced by me regarding pollination and hybridisation.

Schacht.

1. Hermann Schacht (in Pringheim's 'Jahrbucher fur wissensch. Bot.' 1860, II., 109–68, XIV.–XVIII.) gave considerable attention to the subject of pollen-grains, and was, perhaps, one of the earliest investigators to figure and describe one of the forms met with in *Gossypium*. His picture exhibits what he calls the pollen of *G. religiosum*. Schacht's method of staining with dilute sulphuric acid, gives a somewhat striking result, as it colours the outer coat of the grain (the exine) a bright red tint but imparts to the surface of the grain a blue line, due, he believes, to the diffusion of oil over the surface of the grain. Schacht uses the expression of the exine being like a palisade structure, an admirable description, but he shows it as possessing in addition a few hyaline spines that do not arise from warts. A protuberance of the intine and cell-contents is shown to press against the exine, causing it to become thin and finally to rupture. No specially constructed pores are, however, indicated, though numerous perforations and thinning portions are shown. The condition indicated much resembles that in **Plate 52, ff. 1 & 5, also 53, f. 13.**

The thickening of the intine, and the thinning of the exine, is



No. 53. CHARACTERISTIC POLLEN GRAINS OF WILD AND CULTIVATED SPECIES OF GOSSYPIUM.

11. *G. barbadense* (River's Sea Island) × 450 times life size; 12. *G. Nanking*, var. Roji × 450; 13. *G.* hybrid (Ghogari × Varadi) = *hirsutum*, spore × 450; 14. Ditto = *Nanking*, spore × 450; 15. Ditto = *obtusifolium*, spore × 450; 16. *G. punctatum, var. jamaica* × 300; 17. *G. Palmerii* × 300; 18. *G. brasiliense* × 450; 19. *G. taitense* × 300; 20. *G. peruvianum* × 300; and 21. *G. Kirkii* × 300.

described by Sachs and other authors, but no one seems to have noted that while Schacht's picture and description are true of many cottons there are other species that manifest totally different conditions: namely, those described by Strasburger, and also by Sachs, as present in *Malva* and *Althœa*.

Strasburger.

2. Strasburger furnished, however, an admirable series of illustrations of the pollen-grains of *Malva crispa* ('Lehrbuch der Bot.' 1894, p. 368) which were presumed apparently to exemplify a condition that prevailed in the MALVACEÆ. The sculpturings (as they are sometimes called) of the exine, shown by Strasburger as characteristic of *Malva*, closely resemble those of *G. arboreum* and other species of *Gossypium*. (See Plate 52, ff. 4 & 7 and 53, ff. 15 & 18.)

Sachs.

3. Sachs ('Text-book of Botany,' Vine's transl., 2nd ed., 1882, p. 555) gives an interesting review of the information then available. He remarks that the characteristic features of the outer wall of the grain often depend on the number, position, and nature of the openings or perforations in the outer wall. His drawing depicts pores or channels between the surface warts. The illustration given manifests the condition seen in *Althœa rosea*, but it is also present in some of the cottons, as, for example, in *G. barbadense* (Plate 53, f. 11). Through the openings or rupturings of the exine, the hernia-like protuberances of the intine emerge—the pollen tubes.

Edgeworth.

4. Mr. M. Pakenham Edgeworth devoted many years to the study of the pollen-grains of the chief groups and families of plants, and wrote a most useful little book on 'Pollen,' the second edition of which was published in 1879. He does not seem, however, to have taken up any one family and investigated all its species and cultivated forms (such as Mr. Slater has even already accomplished with *Gossypium*), and accordingly Edgeworth arrived at no very definite conclusions as to the value (if any) of the forms of grains as denoting genera, still less species. He figures, describes, and gives the measurements, of some 438 different grains, and thus affords many useful particulars regarding the subject collectively.

In connection with VIOLACEÆ, Edgeworth points out that a hybrid between *Viola tricolor* and *V. cornuta* showed 'some of the characteristics of both parents. This is very remarkable, as Mr. Worthington Smith has pointed out that it is impossible to cross species which have different pollens; but this does not seem to be universally the case, at any rate. No doubt the subject will be carefully examined by hybridists, to whom it is most important.' I am not aware that this subject has been materially advanced since Edgeworth penned these words, though numerous writers have mentioned the discovery of more than one kind of grain in the anthers of one and the same plant.

5. Several instances of this might be mentioned, but one or two may suffice in this connection. It has been observed that while the majority of the forms of sweet peas have 'long pollen-grains,' one, the 'Emily Henderson,' has usually 'round grains.' It has further been recorded that when round-grained 'Henderson,' with pure white flowers, was crossed with long-grained 'Henderson,' also with pure white flowers, the result was seed which gave the old purple sweet pea (with chocolate-coloured standards and blue purple wings), but no manifestation appeared of the white condition of

the stocks used in the production of the cross. The progeny had, moreover, long pollen-grains, which was thus demonstrated as the dominant condition and such a result would ordinarily be spoken of as an instance of 'reversion.' But the modern school of hybridists accepts it as an axiom that when dissimilar gametes are crossed the resultant is the reappearance of an ancient form. And further, such reversions do not breed true, but, on the contrary, split in the next generation or so into the components of their production. (Cf. with remarks under *G. arboreum, var. assamica*, p. 111.)

Lindau.

6. Lindau (Engler and Prantl, IV. 3 B., pp. 274–336) has advanced a classification of the genera of ACANTHACEÆ in which the characteristics of the pollen-grains are accepted as generic and of value in systematic study.

Marshall Ward.

7. The late Professor H. Marshall Ward, in his fascinating new work on 'Trees' (1905, III. 93), says: 'Another curious fact is the co-existence of more than one shape in the same flower. This is well seen in the Black Currant, where the grains may be shaped like a tetragonal pyramid, or cone, truncate or not; or a four-angled prism, with the faces plane or curved; or even a globoid or deformed and creased body. No doubt some of such polymorphic grains are imperfect, and the shape varies (as does that of all pollen-grains) according as viewed in dry, or in some water-extracting medium, such as alcohol or glycerine; but polymorphic pollen-grains are known for many other plants, of which I may mention the Rowan, and are very commonly found of two sizes in different or in the same flowers, *e.g.* in the Tamarisk.'

8. Crépin (*Rosa Hybridæ, Bull. Soc. Roy. de Bot. de Belgique*, vol. 33, 1894, pp. 8–9) draws attention to the diversity, and imperfectly formed pollen-grains as an almost certain indication of hybridisation.

Enough has perhaps been said in exemplification of the great diversity of form and size manifested by the cultivated cottons. With other plants the explanation is often accepted without question that such multiplicity and diversity are indicative of complexity in hybridisation. That suggestion is pregnant with interest to the cotton cultivator. The experiments at cotton improvement, hitherto published, have consisted in field selection of accidental appearances, without, in but few instances, the effort having been put forth to test the origin, purity or dominance of the conditions subjected to protracted elimination.

Mendelism.

Mendel ('Exper. in Pl. Hyb.,' transl. by W. Bateson in 'Jour. Roy. Hort. Soc. Engl.,' vol. 26, 1901, pp. 1–32) in his historic and epoch-making essay on the hybridisation of the edible pea (*Pisum sativum*) laid it down that 'those characters which are transmitted entirely, or almost unchanged in the hybridisation, and therefore in themselves represent the hybrid characters, are termed the *dominant*, and those which become latent in the process, *recessive*.' But by subsequent cultivation Mendel found that the individuals which then manifested the recessive type continued to

breed true, but that of the dominant there were two degrees or conditions, which it might even be possible to distinguish by structural characteristics: namely, those which were found ever after to breed true (pure dominants) and those which produced both recessive and dominant forms (impure dominants). It is thus obvious that selection, from the greater prevalence of impure than pure dominants, may result in unstable forms being experimented with, and thus necessitate years of selection in place of the rapid, one might almost say immediate, results that are possible.

Library
N. C. State College

APPENDIX A

Enumeration of the SPECIMENS of Gossypium Examined by Me in Preparing this Work

Figures when placed following the names assigned to the species, varieties, &c., denote pages in the text. Figures preceding the names are the numbers (if any) given by the collectors to the plants in question. An effort has been made to mention each specimen only once, and that as far as possible under the name of the collector. Occasionally, however, collective lists have had to be given, such as those under 'Calcutta,' 'Sloane,' 'Wallich,' &c. A certain amount of duplication has accordingly been unavoidable, more especially where mistakes in determination have been made by the collectors or by the persons who have distributed the collections. For example, the cottons collected by Hamilton will be found under 'Hamilton,' and not in addition under 'Calcutta,' 'Edinburgh' and other herbaria where duplicates of Hamilton's plants exist, unless where mistakes have been made.

Aitchison, Dr. J. E. T.: **nn. 462 (Thal) 46 (Jhelum)** = G. Nanking, *Meyen*, var. himalayana, *Watt*, 125; . . . **n. 1,034(Khorasan)** = G. herbaceum, *Linn.*, 158.

Alexander, Mr. C.: (in herb. Edinb.) named G. siamense = G. purpurascens, *Poir.*, 252.

America, U.S. Dept. Agri.: The following are the chief specimens supplied by Mr. Lyster H. Dewey in connection with this work:—

Hawaiian cotton = G. tomentosum, *Natt.*, 70; . . . **n. 606 Japanese Wool'** = G. arboreum, *Linn.* var. neglecta, *Watt*, 98; . . . **n. 597 'Aoki'** = G. Nanking, *Meyen*, 123; . . . **n. 596 'Kawasaki'** = G. Nanking, *Meyen*, 117, 123; . . . **n. 607 'Murasaki'** = G. Nanking, *Meyen*, 117, 123; . . . **n. 534 'Korean'** = G. Nanking, *Meyen*, 118, 123; . . . **Transcaucasian** = G. Nanking, *Meyen*, 124; . . . **n. 600** is said to be **'Garo Hill'** (but incorrectly) = G. Nanking, *Meyen*, var. Bani, *Watt*, 118, 124; . . . **'Coton noir choa'** from **Abyssinia** = sp. nov. near G. punctatum, *Sch. et Thon.* var. nigeria, *Watt*; . . . **'Texas Wool'** = G. punctatum, *Sch. et Thon.*, 169, 181; . . . **n. 598, 'Moqui Indian'** = G. punctatum, *Sch. et Thon.*, 169, 181, 224; . . . **n. 11 'King's Improved'** = G. punctatum, *Sch. et Thon.*, 169, 181–2, 207, 209, 233, 238; . . . **nn. 615, 616, 'Molango'** = G. hirsutum, *Linn.*, var. near punctatum, 231; . . . **'Truitt'** = G. hirsutum, *Linn.*, 238; . . . **n. 604** = G. hirsutum, *Linn.* var. religiosa, *Watt*, 201; . . . **'Griffin'** = G. hirsutum, *Linn.* var. religiosa, *Watt*, 201. . . . **n. 599, 'Durango'** = G. mexicanum × hirsutum, 231; . . . **n. 2, 'Mexican cotton'** = G. mexicanum, *Tod.* × G. hirsutum, *Linn.*, 231; . . . **n. 5 'Mexican cotton'** = G. hirsutum × mexicanum, 231; . . . **n. 6, 'Mexican cotton'** = G. mexicanum, *Tod.* × hirsutum, *Linn.*, 231; . . . **n. 2 'Jackson's Limbless'** = G. hirsutum, *Linn.* × G. mexicanum, *Tod.*, 232, 238; . . . **n. 608 'Chaco'** = G. hirsutum, *Linn.* × G. mexicanum, *Tod.*, 232; . . . **'Welborn's Pet'** = G. mexicanum, *Tod.* × hirsutum, *Linn.*, 232; . . . **'Willet's**

Red Leaf' = G. mexicanum, *Tod.* × purpurascens, *Poir.*, 232; . . . **'Parker'** = G. mexicanum, *Tod.* × hirsutum, *Linn.*, 233; . . . **'Okra'** = G. Schottii × punctatum, *Sch. et Thon.*, 206, 233–4; . . . **'Layton's Improved'** = G. mexicanum, *Tod.* × hirsutum, *Linn.*, 234; . . . **n. 457 'Peterkin'** = G. mexicanum, *Tod.* × vitifolium, *Lamk.*, 234, 238; . . . **'Toale'** = G. mexicanum, *Tod.* × hirsutum, *Linn.*, 234; . . . **'Shine'** = G. mexicanum, *Tod.* hybrid, 234; . . . **'Lewis Prize'** = G. mexicanum, *Tod.* hybrid, 234: . . . **'Allen Long Staple'** = G. hirsutum, *Linn.* hybrid, 235; . . . **'Peeler'** = G. hirsutum, *Linn.* hybrid, 235; . . . **Simms'** = G. mexicanum, *Tod.* × hirsutum, *Linn.*, 235; . . . **'Sunflower'** = G. hirsutum, *Linn.* hybrid, 236; . . . **'Todd'** = G. mexicanum, *Tod.* × hirsutum, *Linn.*, 236; . . . **'Russell'** = G. hirsutum, *Linn.* × mexicanum, *Tod.*, 236; . . . **'Berry's Big Boll'** = G. mexicanum, *Tod.* × hirsutum, *Linn.*, 237; . . . **'Culpepper'** = G. mexicanum, *Tod.* × hirsutum, *Linn.*, 237; . . . **'Cummings'** = G. mexicanum, *Tod.* × hirsutum, *Linn.*, 237; . . . **'Triumph'** = G. mexicanum, *Tod.* × hirsutum, *Linn*, 237; . . . **'Gibson Upland American'** = G. mexicanum, *Tod.* × hirsutum, *Linn.*, 238; . . . **'Myers'** = G. mexicanum, *Tod.* × hirsutum, *Linn.*, 238. . . . **'Wild cotton'** = G. purpurascens, *Poir.*, 252. . . . **'Rivers Sea Island'** = G. barbadense, *Linn.* var. maritima, *Watt*, 284; . . . **nn. 14 F.P. & 17 F.P., 'Porto Rico** Sea Island' = G. barbadense, *Linn.* var. maritima, *Watt*, 275; . . . **n. 494 'Black Rattler'** (Sea Island) = G. barbadense, *Linn.* var. maritima, *Watt*; . . . **n. 549 'Sea Island'** = G. barbadense, *Linn.* var. maritima, *Watt*, 277. . . . **n. 176 'Full Rough Catacaoa'** = G. brasiliense, *Macf.*, 302.

Andersson, Mr.: **n. 173** = G. Klotzschianum, *Andss.*, 67.

Andrews, Mr.: **n. 81 (Lake Eyre)** = G. Sturtii, *F. v. M.*, 65.

Ascherson, Mr.: **n. 948 (Dardanelles)** = G. herbaceum, *Linn.*, 158.

Baikie, Dr. W. B.: **(Niger)** = G. arboreum, *Linn.*, var. sanguinea, *Watt*, 92.

Baillon, M.: **n. 128 (Madagascar)** = G. obtusifolium, *Roxb.*, 141.

Baldacci, Dr. A.: **n. 167 (Albania** = G. hirsutum, *Linn.*, 185; . . . **n. 230 (Crete)** = G. herbaceum, *Linn.*, 158.

Balfour, Prof. J. B.: **(B.C. 5) (Socotra)** = G. peruvianum, *Cav.*, 216; . . . **n. 707 (Socotra)** = G. microcarpum *Tod.*, 211; . . . **Rodriguez** = G. taitense, *Parl.*, 249; . . . Rodriguez = G. brasiliense, *Macf.*, 298.

Ball, Herb. specimen (in Edinb.) = G. herbaceum, *Linn.*, 158.

Balls, Mr. W. L.: *see* **Egypt.**

Banks & Solander: **(Java)** = G. arboreum, *Linn.*, var. neglecta, *Watt*, 98; . . . **'G. religiosum' (Tahiti)** = G. purpurascens, *Poir*, 252.

Barclay, G.: **n. 3,084 (California)** = G. Davidsonii, *Kellogg.*, 66; . . . **n. 1,248 (Sandwich Islands)** = G. peruvianum, *Cav.*, 216; . . . **n. 3,275 (Tahiti)** = G. purpurascens, *Poir*, 252.

Baron, Rev. R.: **n. 881 (Madagascar)** = G. taitense, *Parl.*, 249.

Barter, Charles: **n. 1,182 (Niger)** = G. arboreum, *Linn.*, var. sanguinea, *Watt*, 92; . . . **n. 1,184 (Niger)** = G. mexicanum, *Tod.*, 228; . . . **n, 3,349 (Niger)** = G. peruvianum, *Cav.*, 215; . . . **(Mipe)** = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 154; . . . **(Sierra Leone)** = G. punctatum, *Sch. et Thon.*, 171.

Bauer, Dr. G.: **n. 22 (Chatham Island)** = G. Darwinii, *Watt*, 68.

Beaufort, Mary, Duchess (see **Sloane**).

Beckler, Mr.: **n. 1 (Gosse Expedition)** = G. Sturtii, *F. v. M.*, 165.

Beddome, Col. R. H.: **'Uppam cotton' (Kurnool)** = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, 144.

Bell, Mrs. A. S.: **n. 371 (Banda)** = G. Nanking, *Meyen*, var. Bani, *Watt*, 131.

Bent, Mr. J. Th.: **n. 173 (Dhofar)** = G. Stocksii, *M. Mast.*, 75; . . . **n. 131.** *See under* **Lunt**, *also* App. B.

Bentham, G.: **(Greece)** = G. herbaceum, *Linn.*, 158.

Berger: *see under* **Gay.**

Bernoulli & Cario: **n. 3,100 (Guatemala)** = G. barbadense, *Linn.*, 268.

Berthoud-Coulon, M.: n. 249 (Surinam) = G. vitifolium, *Lamk.*, var. ? 258; . . . n. 252 (Surinam) = G. brasiliense, *Macf.*, 299.

Blanchet (ex herb. Shuttleworth): n. 95 (Bahia) = G. brasiliense, *Macf.*, 299; . . . n. 246 (Bahia) = G. brasiliense, *Macf.*, 299.

Boerhaave: *see* Sloane.

Boissier, M.: (Cult. Maloga in DC. herb.) = G. vitifolium, *Lamk.*, 258.

Boivin, M. de: (Madagascar) = G. mexicanum, *Tod.*, 228; . . . (Madagascar) = G. purpurascens, *Poir.*, 251; . . . (Madagascar) (ex herb. Paris) = G. vitifolium, *Lamk.*, 258; . . . (Madagascar) (Nossi Be) = G. brasiliense, *Macf.*, 298.

Bolus, Mr. H.: n. 7,680 (Delagoa Bay) = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 153.

Bourne, G. C.: n. 33 (Diego Garcia Island) = G. purpurascens, *Poir.*, 251.

Bové, M.: n. 317 (Egypt) 'G. vitifolium' = G. peruvianum, *Cav.*, 215.

Bradley, Henry: (China) = G. Nanking, *Meyen*, var. rubicunda, *Watt*, 127.

Brand, Mr.: (Mundane Hills, E. Africa) = G. Kirkii, *M. Mast.*, 317.

Brandis, Sir D.: (Burma) (in Calc. Herb.) = G. punctatum, *Sch. et Thon.*, or G. purpurascens, *Poir.*, 172.

Bretschneider, Dr.: n. 110 (Pekin) = G. Nanking, *Meyen*, 116, 121.

Britton & Rusby: nn. 647 (Yunyas), 1,201 (Cochabamba, Bolivia) = G. peruvianum, *Cav.*, 216.

Brodie, Mr.: n. 80 (Ceylon) = G. Nanking, *Meyen*, var. rubicunda, *Watt*, 127.

Broun, Mr. A. F., & Mrs.: n. 67 (White Nile, &c.), and nn. (Wild) 70, 77, 79, 655 = G. purpurascens *Poir.*, 251; . . . n. 693 (Soudan) = G. Nanking, *Meyen*, var. soudanensis, *Watt*, 138; . . . n. 694 (Khartoum) = G. peruvianum, *Cav.*, 215; . . . '*Ashmouni*' = G. microcarpum, *Tod.*, 212; . . . (Nyam-Nyam) = G. brasiliense, *Macf.*, 298.

Brown, H.: n. 74, '*Mit afifi*' (from farm at Wan, Bahr-el-Ghazul) = G. microcarpum, *Tod.*, 211; . . . (ex herb.) (Sierra Leone) = G. peruvianum, *Cav.*, 215.

Brown-Lester, Dr. J.: n. 59 (Gambia) = G. punctatum, *Sch. et Thon.*, 172; . . . n. 59n (Gambia) = G. punctatum, *Sch. et Thon.*, 171.

Brunner, Mr.: n. 32 (Cult. Island St. Ludovic) = G. punctatum, *Sch. et Thon.*, 171; . . . n. 140 (Senegal) = G. punctatum, *Sch. et Thon.*, 171; . . . (St. Ludovic, Senegal) = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 154.

Buchanan-Hamilton, Dr. F.: *see* Hamilton.

Burbidge, F. W.: (N. Borneo) = G. brasiliense, *Macf.*, 299; . . . (Labuan) = G. brasiliense, *Macf.*, 298.

Burchell, W. J.: n, 6,755 (Brazil 1825–9) = G. brasiliense, *Macf.*, 298.

Burkill, J. H.: (H.B.C. Plants named 'G. obtusifolium, *Roxb.*' = G. Nanking, *Meyen*, var. rubicunda, *Watt*, 141; 314; *see also under* R.E.P.

Burton, Sir R.: (Congo) = G. peruvianum *Cav.*, 215.

Bushell, Dr. S. W.: (Pekin) 'G. herbaceum,' *Linn.*, = G. Nanking, *Meyen*, 116.

Busse, Dr. W.: n. 184 (East Africa) = G. ? microcarpum, *Tod.*, 211; . . . n. 184 (Dutch East Africa) = G. brasiliense, *Macf.*, 298.

Calcutta Herbarium Specimens: . . . H.B.C. = G. Nanking, *Meyen*, var. rubicunda, *Watt*, 117, 127; . . . H.B.C. = G. obtusifolium, *Roxb.* var. Wightiana, *Watt*, 150; . . . H.B.C. 'G. religiosum' = G. punctatum, *Sch. et Thon.*, 172; H.B.C. (Kurz) = G. Schottii sp. nov., 207; . . . H.B.C. (Mauritius seed) = G. purpurascens, *Poir.*, 252; . . . H.B.C. = G. vitifolium, *Lamk.*, 256; . . . H.B.C. 'G. acuminatum' = G. barbadense, *Linn.*, 268; . . . (Triplicany) = G. arboreum, *Linn.*, var. neglecta *Watt*; . . . *Keroa Kapas* = G. arboreum, *Linn.*, var. neglecta, *Watt*; . . . Palembang Madras (the original possibly of the *jowari hathi* of to-day) = hybrid G. mexicanum, *Tod.*, × obtusifolium, *Roxb.*, 149, 152–3, 339; . . .

Naidoo, T. Kistnasawmy: = G. purpurascens, *Poir.*, 252; . . . **Jenkins & McClelland (Assam)** = G. purpurascens, *Poir.*, 252; . . . **(Triplicany)** = Hybrid of G. brasiliense × purpurascens, *Poir.*, 295.

See also under Gamble, Griffith, Hamilton, Hooker, Kurz, Masters, Prain, Rottler, R.E.P. Schmid, Wallich, Wight, &c.

Caldwell, Mr. E.: **(New Caledonia)** = G. purpurascens, *Poir.*, 251.

Camel: *see* **Sloane** *under* Petiver *and* Plukenet.

Cameron, Lieut. **(Tanganika)** = G. brasiliense, *Macf.*, 298, 311.

Campbell, J.: **(Madras)** = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, 145.

Candolle, M. de.: (in Herb. Geneva) = G. punctatum, *Sch. et Thon.* var. prostrata, *Watt*, 174.

The specimens of M. Casimer de Candolle's Geneva Herbarium are quoted under the names of the collectors, *e.g.* Andersson, Blanchet, Boissier, Hahn, Fortune, Morrenhout, Murray, Roche, Sagot, Schimper, Zollinger, &c.

Carles, W. R.: **n. 388 (Shanghai)** = G. hirsutum, *Linn.*, 185; . . . **(Pekin** hills) = G. Nanking, *Meyen*, 117; . . . **(Shanghai)** = G. arboreum, *Linn.*, var. neglecta, *Watt*, 98.

Catholic Mission **(Bahr-el-Ghazar)** = G. mexicanum, *Tod.*, 228.

Clarke, C. B.: **n. 6,770 (Dacca)** = G. purpurascens, *Poir.*, 252.

Clarke, Major T.: **(Brazil)** = G. purpurascens, *Poir.*, (hybrid), 252. *See* General Index, 'Hybrids.'

Cleghorn, Dr.: **(North Panjab)** = G. arboreum, *Linn.*, 84.

Clifford Herb. (in B.M.): **(Barbados)** named 'G. arboreum 3' = G. mexicanum, *Tod.*, 228; . . . (in B.M.) 'G. herbaceum' = G. herbaceum, *Linn.*, 158.

Coimbatore; **n. 15, 367** (collector unknown) = G. purpurascens, *Poir.*, 252.

Combs, R.: **n. 609 (Cuba)** = G. brasiliense, *Macf.*, 298.

Cook: Round the World specimens, *see under* Banks and Solander.

Cooke, Dr.: **(Karachi)** = G. Stocksii, *M. Mast.*, 75.

Crosby, Mr. C. S.; **(Tonga Islands)** = G. brasiliense, *Macf.*, 298.

Cuninghame, James: *see* **Sloane.**

Cunningham, Allan: **(Australia)** = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, 145.

Cuming, Hugh: **n. 1,647 (Philippine Islands)** = G. arboreum, *Linn.*, var. neglecta, *Watt*, 98.

Cummins, Dr. H. A.: **n. 13F. (Ashanti)** = G. peruvianum, *Cav.*, 215.

Curtiss, A. H.; **n. 135 (Bahamas)** = G. barbadense, *Linn.*, 268; . . . **nn. 386***a* and **5,655** named 'G. uliginosum' = G. punctatum, *Sch. et Thon.* 170.

Dalzell, N. A.: **n. 4 (Karachi)** = G. Stocksii, *M. Mast.*, 75.

Darwin, Mr. Charles: **(Galapagos Islands)** = G. Darwinii, *Watt*, 68.

Delavay, M. l'Abbé: **(Yunan)** = G. Nanking, *Meyen*, 116.

Deplanche, M.: **nn. 130, 417 (New Caledonia)** named 'G. religiosum,' = G. taitense, *Parl.*, 249.

Dewey, Lyster H.: *see* **America.**

Don, Mr. G.: (specimen in B.M.) = G. punctatum, *Sch. et Thon.*, 171.

Drummond, Mr. Thomas: **n. 1,832 (Alabama)** = G. punctatum, *Sch. et Thon.*, 170, 181; . . . **(St. Louis**, Missouri) = G. hirsutum, *Linn.*, var. religiosa, *Watt*, 202.

Dubois: *see* **Sloane** (Pluk.).

Dudgeon, G. C.: **(Gold Coast)** = G. punctatum, *Sch. et Thon.*, 171, 178; . . . 'Kidney cotton of **Sittam**' also **Labolabo** (black seed) = G. vitifolium, *Lamk.*, 258.

Duthie, Mr. J. F.: **n. 4,560,** *Ban kukri* **(Rajputana)** = G. brasiliense, *Macf.*, 298, 314; . . . **n. 12,312 (Gilgit)** = G. punctatum, *Sch. et Thon.*, 172; . . . **n. 19,261 (Hazara)** = G. Nanking, *Meyen* var. himalayana, *Watt*, 125; . . . **(Ushtarzai) n. 20,836** = G. arboreum, *Linn.*, var. neglecta, *Watt*, 97; . . . **n. 21,603 (Gorakhpur)** = G. Nanking, *Meyen*, var. rubicunda, *Watt*, 127; . . . **n. 21,604 (Kheri** district) = G. arboreum, *Linn.*, var. neglecta, *Watt*, 97.

Edgeworth, M. P.: **n. 231** (**North-west India**) = G. arboreum, *Linn.*, 83–4.

Edinburgh Herb.: **n. 578** (**Dominica**) = G. purpurascens, *Poir.*, 252.

The specimens are quoted under the names of the contributors, *e.g.* Balfour, Brodie, Hamilton, &c.

Eggers, Mr.: **n. 242** (**St. Thomas**) = G. barbadense, *Linn.*, 268.

Egypt: Etat-Major General Egyptien, **n. 61** (**Darfour**) = G. obtusifolium, *Roxb.* var. africana, *Watt*, 154; *also* the specimens contributed for this work by Mr. Lawrence Balls: . . . **n. 213-1** = G. arboreum, *Linn.*, var. near rosea, *Watt*, 113; . . . **n. 213-2** = G. Nanking, *Meyen*, var. soudanensis, *Watt*, 138; . . . '**Moqui** Cotton' = G. punctatum, *Sch. et Thon.*, 181; . . . **n. 55a** = ? G. punctatum, *Sch. et Thon.* × G. vitifolium, *Lamk*; . . . **n. 209-3** = G. punctatum, *Sch. et Thon.*, 181, 224, 292; . . . **n. 207-2** = G. ? microcarpum, *Tod.* hybridised by mexicanum or hirsutum, 212; . . . '**Afifi** or Egyptian cotton' = G. peruvianum, *Cav.*, 215, 224; . . . '**Abassi** or Egyptian cotton' = G. peruvianum, *Cav.*, 215, 224; . . . **n. 50** = G. hirsutum, *Linn.*; . . . **n. 43 A2** = G. hirsutum, *Linn.*, 224; . . . **n. 250** = G. hirsutum, *Linn.*, × G. peruvianum, *Cav.* 224; . . . **n. 56 C2** = G. peruvianum, *Cav.*, 224; . . . **n. 142A** = G. peruvianum, *Cav.*, 224; . . . **n. 158 C2** = G. peruvianum, *Cav.*, 224; . . . **Egyptian** named 'G. barbadense' = G. vitifolium, *Lamk.*, 258, 312; . . . **n. 317** = G. vitifolium, *Lamk.*, 258; . . . **n. 89 B** = G. barbadense, *Linn.*, 292; . . . **n. 211** = G. brasiliense, *Macf.*

Elliot, G. F. Scott: **n. 2,103** (**Madagascar**) = G. peruvianum, *Cav.*, 216.

Elliott, W. R.: **n. 135** (**N. Nigeria**) = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 154.

Faber, Rev. E.: **n. 580** (**Yangtzekiang**) = G. Nanking, *Meyen*, 116.

Falconer, Dr. H.: **n. 286** (**Cult. Saharanpur**) = G. vitifolium, *Lamk.*, 258; . . . **n. 287** (**Kashmir**) and **288** (**Panjab**) = G. Nanking, *Meyen*, var. himalayana, *Watt*, 125.

Farmar, Leo: **n. 218** (**French Guinea**) = G. obtusifolium, *Roxb.* var. africana, *Watt*, 154; G. punctatum, *Sch. et Thon.*, 191.

Fendler, Mr.: **n. 226** (**Trinidad**) = G. barbadense, *Linn.*, 268.

Fisher, Mr.: **n. 197** = G. arboreum *Linn.* var. neglecta, *Watt*, 98.

Forbes, Mr.: **nn. 101, 139** (**Kinkiang**) = G. Nanking, *Meyen*, 116.

Forester, Mr.: Liverpool (**Barbados**) = G. barbadense, *Linn.*, 268.

Forester, J. R. & G.: (**Tahiti**) = G. taitense, *Parl.*, 249.

Forskal: (**Arabian** plant named by him 'G. rubrum') = G. arboreum, *Linn.*, 158; . . . (**Arabian** plant he named 'G. arboreum') = G. herbaceum, *Linn.*, 161.

Forsyth: (ex herb. Roxb.) = G. Nanking, *Meyen*, var. rubicunda, *Watt*, 126.

Fortune, R.: **China** = G. arboreum, var. neglecta, *Watt*, 98; . . . **n. 116a** (**Shanghai**) = G. Nanking, *Meyen*, var. Bani, *Watt*, 132; . . . **n. 116a** = var. Nanking × neglecta, 98; . . . **n. 66** (**Shanghai**) = G. Nanking, *Meyen*, 116.

Freyn, J.: **n. 1,164** (**Aschabad**, Transcaspian Persia) = G. hirsutum, *Linn.*, 185.

Gage, Capt. A. T.: *see under* **Calcutta**, 108, 141.

Galpin, E. E.: **n. 742** (**Barberton**, S. Africa) = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 153.

Gamble, J. S.: **n. 16,037** (in Calc. herb., **South India**) = G. Nanking, *Meyen*, var. Nadam, *Watt*, 129.

Gammie, G.: (**Kashmir**) = G. Nanking, *Meyen*, var. himalayana, *Watt*, 125; . . . **hybrids** of, *see* Hybrids and Hybridisation in General Index.

Garcke—determined **Sintenis'** collections, which see.

Gardner: **n. 1,463** (**Ceara**, Brazil) = G. mustelinum, *Miers*, 168, 299.

Gaudichaud, M.: (in DC. herb.) = G. Nanking, *Meyen*, var. rubicunda, *Watt*, 127.

Gay, J.: **n. 44**, named G. barbadense = G. peruvianum, *Cav.*, 215; . . . **n. 646** named G. her-

baceum, var. frutescens = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 154; . . . ex herb. Berger, **Greece** = G. herbaceum, *Linn.*, 158; . . . **ex Jard. de Morel** = G. hirsutum, *Linn.*, var. religiosa, *Watt*, 202; . . . (**Teneriffe**) = G. microcarpum, *Tod.*, 211; . . . specimens named 'G. hirsutum' (**Greece**) and 'G. vitifolium' (**Spain**) = G. peruvianum, *Cav.*, 215; . . . ex herb. V. Jacquemont named 'G. hirsutum'? *Pers.* = G. purpurascens, *Poir.*, 252; . . . **Senegal** Cotonier de Géorgié = G. vitifolium, *Lamk.*, 258.

Gibery: **n. 1,025** (**Paraguay**) = G. brasiliense, *Macf.*, 298.

Giles, Dr.: **n. 250** (**Gilgit**) = G. herbaceum, *Linn.*, 158.

Glaziou, Dr. A.: **n. 8,880** (**Brazil**) = G. brasiliense, *Macf.*, 298.

Goetze, W.: **n. 75** (**Nyassaland**) = G. obtusifolium, *Roxb.* var. africana, *Watt*, 153.

Grant, Dr. W. B.: (**Natal**) = G. peruvianum, *Cav.*, 215.

Greyi, Albro: **n. 128** (**Madagascar**) = G. Nanking, *Meyen*, var. Roji, *Watt*, 135.

Griffith, Dr. W.: specimen collected **Serampore** marked '**W. G.**' (preserved in Cambridge herb.) = G. arboreum, *Linn.* var. neglecta, *Watt*, 98; . . . (**Ava**) **n. 51** = G. Nanking, *Meyen*, var. Nadam, *Watt*, 129; . . . **n. 99** = G. arboreum, *Linn.* var. neglecta, *Watt*, 98; . . . (**Bhutan**) = himalayana × neglecta hybrid, 125; . . . (**Kabul**) ex Wade = G. Nanking, *Meyen*, var. rubicunda, *Watt*, 126–7.

Crisebach: **n. 19** (**West Indies**) = G. mexicanum, *Tod.*, 228; . . . (**St. Kitts**) = G.? brasiliense, *Macf.*, 268, 271.

Habel, Dr.: (**Galapagos**) = G. Darwinii, *Watt.*, 68.

Hahn, L.: **n. 492** = G. brasiliense, *Macf.*, 299; . . . (**Martinique**) glabrous form = G. barbadense, *Linn.*, 268; . . . **hybrid** of G. vitifolium, *Lamk.*, 244.

Hamilton, Dr. F. (formerly Buchanan): . . . **n. 1,543** 'G. nigrum, rubicundum, *Ham.*' = G. arboreum, *Linn.*, var. sanguinea, *Watt*, 85, 92, 93–4; . . . **n. 1,550** 'G. nigrum laeve' (**Sibganj**) = G. purpurascens, *Poir.*, 252; . . . **nn. 1,552, 1,553** 'G. viridescens, var. hirsuta, *Ham.*, and var. herbacea, *Ham.*' = G. arboreum, *Linn.* var. neglecta, *Watt*, 93, 94, 98, 99; . . . (**Rangoon**) = G. Nanking, *Meyen*, var. Nadam, *Watt*, 129.

The best set of Hamilton's cottons is in the Edinburgh Herb., though sets are also to be found in the Kew and British Museum Herbaria, but mostly incorporated in Wall. Cat. *which see.*

Hance, Dr. H. F.: **n. 32,295** = G. purpurascens, *Poir.*, 253.

Hassler, E.: **n. 484** (**Paraguay**) 'quasi-spontanea' = G. barbadense, *Linn.*, 268; . . . **n. 484** (**Paraguay**) in B.M. = G. Schottii, *sp. nov.*, 207; . . . **n. 7,578** = near G. vitifolium, *Lamk.*, but is possibly *sp. nov.*, 256–7, 258.

Haussknecht, C.: (**Syria**) = G. herbaceum, *Linn.*, 158; . . . (**Armenia**) = G. mexicanum, *Tod.*, 228.

Haviland and Hose: **n. 3,356** (**Borneo**) = G. brasiliense, *Macf.*, 298.

Haldreich, De: (**Athens**) = G. herbaceum, *Linn.*, 1

H. B. C.: *see* **Calcutta** Herbarium.

Helfer: **n. 44** (**Bengal**) = G. mexicanum, *Tod.*, 228.

Heller, Mr. and Mrs.: **n. 174** = G. brasiliense, *Macf.*, 299.

Helms, R.: (**Elder Exped.**) = G. Sturtii, *F. v. M.*, 65.

Henderson, Dr.: **n. 1,072** (**Yarkand**) = G. Nanking, *Meyen*, 116; . . . (Yarkand) = G. Nanking, *Meyen*, var. himalayana, *Watt*, 125.

Henry, Dr.: **n. 8,305** = G. brasiliense, *Macf.*, 298; . . . (a) **n. 11,024** (**Yunan**); and (b) **n. 1,899** (**Formosa**) = Nanking, *Meyen*, 116.

Higginson, W.: (**Badagry**) = G. punctatum, *Sch. et Thon.*, 171.

Hildebrandt: **n. 1,208** = G. Nanking, *Meyen*, var. Bani, *Watt*, 132; . . . **n. 692** = G. Nanking, *Meyen*, var. Bani, *Watt*, 132.

Hillebrand: **n. 368** = G. tomentosum, *Nutt.*, 70, 72.

Hinds: (**Magdalena Bay**) = G. Davidsonii, *Kellogg.*, 66.

Hohenack, R. F.: **n. 499** (**Canara**) = G. purpurascens, *Poir.*, 252; . . .

n. 288 = G. herbaceum, *Linn.*, 158; . . . 'G. indicum' (Griechland) = G. mexicanum, *Tod.*, 228.

Holland, J. H.: n. 250 = G. barbadense, *Linn.*, 268.

Hooker also Herb. Ind. Or. Hook. f. and T. T.: n. 65 = G. arboreum, *Linn.*, var. ? neglecta, *Watt*, 98 (duplicate in Calc. Herb., might rather be nov. var. or hybrid neglecta × assamica); . . . n. 421 = G. mexicanum, *Tod.*, 228; . . . St. Vincent specimen in Glasgow Herb. (contributed by Sir W. H.) = G. brasiliense, *Macf.*, 299; . . . Nilgiri and Coorg Hills = G. Nanking, *Meyen*, var. himalayana, *Watt*, 126; . . . (Pabna) = G. purpurascens, *Poir.*, 251; . . . ex herb. Stocks = G. brasiliense, *Macf.*, 298; . . . Moradabad = G. arboreum, *Linn.*, var. neglecta, *Watt*, 97.

Horsfield, Dr. T.: (ex Shuttleworth herb.) = G. arboreum, *Linn.*, var. sanguinea, *Watt*, 93; . . . (Java) = G. barbadense, *Linn.*, 268; . . . (Java) = G. mexicanum, *Tod.*, 228; . . . (Java) = G. vitifolium, *Lamk.*, 258; . . . n. 1,192 'Javan kapas' = G. arboreum, *Linn.*, 84.

Hove, Dr. A. P.: (India, Dholca) = G. obtusifolium, *Roxb.*, var. Wightiana race ? *lalio* ? *Wagria*, 144, 151; . . . Lymree and Mitampur = G. brasiliense, *Macf.*, 299, 313–4; . . . Baroda = G. arboreum, *Linn.*, 84; . . . (Junagadh, Joynegare) = G. Nanking, *Meyen*, var. ? Nadam, *Watt*, 129. (Hove's cottons are in B.M.).

Houstoun, W.: (Jamaica) = G. brasiliense, *Macf.*, 299.

Hutton, J. F.: n. 749 (Colombia) = G. mustelinum, *Miers*, 168.

Irving, Dr.: n. 3 (Abbeokuta) '*Akese*' = G. arboreum, *Linn.* var. sanguinea, *Watt*, 92 (duplicate in Calc. Herb. is almost typical G. arboreum); . . . n. 1 (Abbeokuta) '*Owu*' = G. peruvianum, *Cav.*, 215.

Jacquement, V.: (San Domingo) = G. purpurascens, *Poir.*, 252.

Jamaica specimen in Edinburgh Herb. = G. brasiliense, *Macf.*, 298.

Jameson, Dr. W.: n. 15 (Amballa) = G. arboreum, *Linn.*, var. neglecta, *Watt*, 97; . . . n. 189 (Saharanpur) = G. punctatum, *Sch. et Thon.*, 171; . . . (Saharanpur) (extensive series in several Herbaria) = G. hirsutum, *Linn.*, 185; . . . (Mauritius seed) = G. punctatum, *Sch. et Thon.*, 172; . . . Edinburgh Herb. = G. arboreum, *Linn.*, var. assamica, *Watt*, 109.

Jenkins, F.: (Assam) = G. arboreum, *Linn.*, var. assamica, *Watt*, 109.

Jenman: n. 5,139 (British Guiana) = G. barbadense, *Linn.*, 268; . . . n. 5,785 (Br. Guiana) = G. arboreum, *Linn.*, var. neglecta, *Tod.*, 98; . . . n. 5,149 (Br. Guiana) = G. Nanking, *Meyen*, var. Bani, *Watt*, 134.

Johnston, Sir H. H.: (Karkatown) = G. peruvianum, *Cav.*, 215; . . . (Nyassaland) = G. microcarpum, *Tod.*, 211.

Johnson, W. H.: n. II (Gold Coast) = G. punctatum, *Sch. et Thon.*, 171, 178; . . . n. III (Anum, Gold Coast) = G. hirsutum, *Linn.*, 185; . . . (Gold Coast) cultivated = G. peruvianum, *Cav.*, 215.

Johnson, Rev. W. P.: (Portuguese Nyassaland) = G. microcarpum, *Tod.*, 211; . . . (Lake Nyassa) = G. brasiliense, *Macf.*, 298, 311.

Jumel cotton. No authentic specimen seen; a doubtful one in DC. herb., 258. *See* General Index.

Junod, H. A.: n. 658 (Austro-Africa) = G. microcarpum, *Tod.*, 211.

Kaessner: n. 611 (Br. E. Africa) in B. M. = G. ? brasiliense, *Macf.*, 299; . . . (Br. E. Africa) in Kew = G. peruvianum, *Cav.*, 215; . . . n. 28 (N. Bote) = G. Kirkii, *M. Mast.*, 317.

Keenan: (Cachar) = G. arboreum, *Linn.*, ? hybrid neglecta × assamica, *Watt.*, 98.

Kelaart, specimen from Ceylon = G. arboreum, *Linn.*, 84.

Kirk, Sir J.: '*Tonge kaja*' (Zambesi) = G. Nanking, *Meyen*, var. Roji, *Watt*, 135; . . . '*Tonja kaja*,' n. 283 (Zambesi Exped.) = G. obtusifolium, *Roxb.*, var. africana, *Watt*,

154; . . . **n. 284** (Livingstone's Zambesi Exped.) = G. hirsutum, *Linn.*, 185; . . . (Zambesi Exped. calls it Pernambuco) = G. microcarpum, *Tod.*, 211; . . . (Highlands of **Batoka**—Livingstone's Exped.) = G. peruvianum, *Cav.* (is probably G. microcarpum, *Tod.*, 215; . . . (Lower **Shiré** Valley) = G. mexicanum, *Tod.*, 228; . . . **Kongone** mouth of Zambesi) = G. purpurascens, *Poir.*, 251; . . . (**Tette**, Zambesi) = G. barbadense, *Linn.*, 268; . . . (Livingstone's Exped. **Luabo** River) = G. brasiliense, *Macf.*, 298, 311; . . . (**Dar-es-Salaam**) = G. Kirkii, *M. Mast.*, 317; . . . (**Batoka** Highlands) = G. brasiliense, *Macf.*, 298; . . . (**Bazuzulu**) = ? G. peruvianum, *Cav.*, or G. microcarpum, *Tod.*, 215.

Kirk and Livingstone's cottons are in Kew Herbarium.

Klotzsch, Dr. F.: **Galapagos** cotton, G. Klotzschianum, *Andss.*, 67.

Koch, Max: **n. 12 (Lynhurst)** = G. Sturtii, *F. v. M.*, 65.

Kurz, Dr. S.: '**H.B.C.**' (in Calc. herb.) = G. Schottii, *Watt*, 207; . . . G. obtusifolium, var. rubicunda, 117; . . . (Cult. **Sibpur** in Calc. herb.) = G. purpurascens, *Poir.*, but comes near to G. taitense, *Parl.*, 252; . . . (**Andaman Islands**) = G. purpurascens, *Poir.*, 251; . . . (H.B.C.) named G. acuminatum = G. ? barbadense, *Linn.*, 268.

Kurz's cottons are in the Calcutta Herbarium.

Lace, J. H.: **n. 1,836 (Chamba)** = G. Nanking, *Meyen*, var. himalayana, *Watt*, 125.

Lagos, common cotton of = G. peruvianum, *Cav.*, 215.

Leake, Mr.: Saharanpur herb. sp. sent on inspection, 110.

Lehmann, F. C.: **n. 1,912 (Costa Rica)** = G. peruvianum, *Cav.*, 216, 299.

Lemann: (specimen from **H.B.C.**) named by Bentham as **G. obtusifolium** = G. Nanking, *Meyen*, var., rubicunda, *Watt*, 117.

Levy, P.: **n. 381 (Nicaragua)** = G. mexicanum, *Tod.*, 228.

Linnean Herbarium, London: . . . *Linn.*, **n.** '**1 herbaceum H. U.**' = G. herbaceum, *Linn.*, 158 (Plate No. 24A); ' . . **n.** '**2 praestantissimum**' (Plate No. 17A) = G. Nanking, *Meyen*, var. rubicunda, *Watt*, 127; . . . **n.** '**3 arboreum**' (Plate No. 7C) = G. arboreum, *Linn.*, 83-4; . . . '**barbadense ?, H.U.**' (Plate No. 19A) = G. obtusifolium, *Roxb.*, 140, 269; . . . '**hirsutum, Surat**' (Plate No. 21A) = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, 144; . . . '**religiosum**' (Plate No. 32A) = G. hirsutum, *Linn.*, var. religiosa, *Watt*, 201; . . . '**barbadense ?**' (Plate No. 24C) = G. herbaceum, *Linn.*, 158, 269; . . . '**Gossypium Surin**' (Plate No. 49A) = G. ? brasiliense, *Macf.*, 258, 301.

Livingstone: *see* Kirk.

Lowe, R. F.: (**Madeira**) = G. punctatum, *Sch. et Thon.*, 171.

Lugard, Mrs.: **n. 198 (Kwebe Hills)** = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 153.

Lunt, W.: **n. 131 (Hadramaut Exped.)** = G. Nanking. *Meyen*, var. Roji, *Watt*, 135.

Lyell, Catherine: (**Agra**, Meerut) = G. arboreum, *Linn.*, var. neglecta, *Watt*, 98.

MacCarthy, G.: two specimens from **Carolina** and **Alabama** (in Camb. herb.) = G. hirsutum, *Linn.*, 185.

McClelland, Dr.: (**Assam**) = G. arboreum, *Linn.*, var. assamica, *Watt*, 108; . . . (Assam 1846) = G. purpurascens. *Poir.*, 252.

MacNab, Dr.: (**Jamaica**) = G. punctatum, *Sch. et Thon.*, 171.

MacRae: (Mowee in **Sandwich Islands**) = G. tomentosum, *Nutt.*, 70; . . . (Sandwich Islands, 1825) = G. brasiliense, *Macf.*, 299.

Malindi, East African Protectorate = G. Kirkii, *M. Mast.*, 317.

Mann & Brigham, n. 228, (Oahu, Sandwich Islands) = G. tomentosum, *Nutt.*, 70.

Marshall, Dr. J.: (? **Virginia 1698**) = G. vitifolium, *Lamk.*, 258, *see* **Sloane.**

Masters, J. W.: **n. 447** (in Calc. Herb.) = G. arboreum, *Linn.*, var. neglecta, *Watt*; . . . (**Assam** in Kew Herb.) = G. arboreum, *Linn.*, var. assamica, *Watt*, 108, 109; . . . (**Mikur Hills**, Assam—i

Calc. Herb.) = G. Nanking, *Meyen*, var. Nadam, *Watt*, 129.

Matthews: (**Tonga Islands**) **nn. 149** & 150 = G. mexicanum, *Tod.*, 228.

Mauritius: (grown in Calc. Hort. Bot.) = G. purpurascens, *Poir.*, 252.

Maximowicz: (**Yokohama**) = G. Nanking, *Meyen*, 116.

Mehta, R.P.: (**Kathiawar Exp. Farm**) **n. 1,749** = G. punctatum, *Sch. et Thon.*, 172.

Menzies & D. Nelson: (**Hawaii**) = G. tomentosum, *Nutt.*, 70.

Meyer, Dr. A. B.: (Specimens communicated by) 141.

Middleton, Prof. T. H.: (**Baroda**) = G. arboreum, *Linn.*, var. sanguinea, *Watt*, 92.

Miers, J.: **n. 1,055** (**Lima**), **n. 7,573** (**Bolivia**), **n. 1,220** (**Buenos Ayres**) = G. peruvianum, *Cav.*, 216; . . . (**Coimbatore**) named 'New Orleans' = G. hirsutum, *Linn.*, 185; . . . (**Brazil**) = G. brasiliense, *Macf.*, 299.

Miers' cottons are in British Museum.

Millar & Johnston: **n. 207** = G. barbadense, *Linn.*, 268.

Miller, Philip: *see* **Sloane.**

Miller, H.: **n. 28** (**Lagos**) = G. brasiliense, *Macf.*, 298.

Millington, Mr.: (**Jamaica**) (specimens sent to Sir Joseph Banks = G. hirsutum, *Linn.*, 185; . . . (**Barbados**) named 'rabbit-tail,' 'Trinidad Cotton,' &c. = G. brasiliense, *Macf.*, 299.

Millington's specimens are in B.M.

Monro, M.: **n. 73** (**Hazara**) = G. arboreum, *Linn.*, var. neglecta, *Watt*, 97.

Morong, T.: **n. 978** (named 'G. maritimum, var. polycarpum,' *Tod.*) = G. peruvianum, *Cav.*, 216.

Morrenhout, M.: (**Tahiti**) = G. taitense, *Parl.*, 249; . . . (Tahiti —Sea Island) = G. barbadense, *Linn.*, 268.

Mueller, Sir Ferdinand Baron von: (**West Australia**) = G. Robinsoni, *F. v. M.*, 68.

Muriel, C. E.: **n. 51** (**White Nile**) = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 154.

Murray: **nn. 72, 122** (**Jamaica**) = G. hirsutum, *Linn.*, 186; . . . (Jamaica 1827) = G. vitifolium, *Lamk.* 258.

Naples Herb. specimens: Type of = G. microcarpum, *Tod.*, 211.

Naidoo, T. K.: (**Madras**) = G. purpurascens, *Poir.*, 252.

Nicobar Islands: (specimens collected in 1785) = G. obtusifolium, *Roxb.* var. Wightiana × Bani, *Watt*, 144.

Nuttal: (**Owhyhee**) = G. tomentosum, *Nutt.*, 70.

Ogilvie-Grant-Forbes: (Exped. **Garieh Plain, Socotra**) = G. peruvianum, *Cav.*, 216.

Oldenburg: (in Gardens **Cape of Good Hope**, 1772) = G. Nanking, *Meyen*, var. rubicunda, *Watt*, 127.

Oldham: **n. 107** (**Nagasaki**, Japan) = G. Nanking, *Meyen*, 116.

Palmer, Dr. E.: **n. 10** (named 'G. barbadense') (**Laguna** desert seed—cultivated 4 years) (**Mexico**) = G. ? punctatum, *Sch. et Thon.*, 171; . . . **n. 10** (same source, only hybridised during cultivation) = G. ? mexicanum, *Tod.*, 228; . . . **Moqui** from **Mexico** and **Florida**, 181; . . . **n. 110** (**Guaymas, Mexico**) = G. barbadense, *Linn.*, 268; . . . **n. 116** (**Coahuila, Mexico**) = G. punctatum, *Sch. et Thon.*, 170; . . . **n. 244** (**Guaymas, Mexico**) = G. Davidsonii, *Kellogg*, 66; . . . **n. 384** (**Mexico**) = G. Palmerii, *Watt*, 205; . . . **n. 838** (**Carmen Island**, Mexico) = G. Harknessii, *Brandg.*, 73. The specimens here mentioned are to be seen at Kew and British Museum.

Parlatore, F.: (specimen in **Florence** Herb.) = G. arboreum, *Linn.*, var. neglecta, *Watt*, 84; . . . specimens named 'G. barbadense' are mostly = G. peruvianum, *Cav.*, 217.

Parnell, Dr.: (**Montago Bay, Jamaica**) = G. peruvianum, *Cav.*, 216.

Paucher (**New Caledonia**), wrongly named *G. religiosum* = G. taitense, *Parl.*, 249.

Pavon: (in B.M., specimen from **Mexico**) = G. punctatum, *Sch. et Thon.*, 170.

Petherick: (**White Nile** not cultivated) = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 154, 311.

Petiver: *see* **Sloane.**

Petropolitani, Herb. Armenia & Persia; = G. herbaceum, *Linn.*, 158.

Perrottet: (Senegal) = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 154.

Perry, W. W.: (Somali Coast) = G. peruvianum, *Cav.*, 215; . . . (Madagascar) = G. purpurascens, *Poir.*, 251.

Pfund, Dr.; n. 474 (Kordofan) = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 154; . . . n. 496 (Kordofan) = G. hirsutum, *Linn.*, 185.

Pierre: n. 1,043 (Cambodia, Malaya) = G. vitifolium, *Lamk.*, 258; . . . n. 802 (Cambodia, Malaya) = G. brasiliense, *Macf.*, 298.

Playfair, G. M. H.: (Pakhoi, S. China) n. 102 = hybrid of G. hirsutum, *Linn.*, 185.

Plukenet: *see* Sloane.

Ponson: (Rio de Janeiro 1828) = G. brasiliense, *Macf.*, 299.

Prain, Col. D.: (Laccadive in Calc. Herb.) = G. purpurascens, *Poir.*, 252.

Rautanen, M.: n. 59 (Omboland) = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 153.

Rehmann, Dr. A.: n. 5,227 (Boshveld, Transvaal) = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 153.

Rein, Prof.: n. 23 (Japan) = G. Nanking, *Meyen*, 117.

R.E.P. Herb. Calcutta:—
(Watt) n. 1,761 = G. arboreum, Linn., 84 (is possibly near var. sanguinea, *Watt*, 93); . . . (Burkill) n. 21,881 and 21,882 = G. arboreum, *Linn.*, var ? sanguinea, *Watt*, 93: . . . (Watt) nn. 1,747–8, 1,780–3, 1,793, 1,794 = G. arboreum, *Linn.*, var. neglecta, *Watt*, 98; . . . (Burkill) nn. 21,814, 21,895, 21,896, 22,006, 22,010, = G. arboreum, *Linn.*, var. neglecta, *Watt*, 98; . . . (Burkill) n. 22,031 = G. arboreum, *Linn.*, var. assamica, *Watt*, 109; . . . (Burkill) nn. 22,012, 22,029, 22,031, = G. arboreum, *Linn*, var. rosea, *Watt*, 109, 112; . . . (Watt) nn. 7,990, 9,776, 10,210, 13,449, = G. Nanking, *Meyen*, var. himalayana, *Watt*, 125; . . . (Burkill) nn. 21,884, 21,886, 22,007, 22,302. 22,932, 23,797 = G. Nanking, *Meyen*, var. Nadam, *Watt*, 129; . . . (Watt) (Manipur) n. 5,824 = G. Nanking, *Meyen*, var. Nadam, *Watt*, 129; . . . (Burkill) nn. 21,874, 21,876, 21,878, 21,889, 21,891, 22,034 = G. Nanking, *Meyen*, var. Bani, *Watt*, 131–2; . . . (Watt) n. 1,799 = G. Nanking, *Meyen*, var. Bani, *Watt*, 132; . . . (Watt) (Baroda) nn. 1,741, 1,872 = G. Nanking, *Meyen*, var. Roji, *Watt*, 135; . . . (Watt) n. 1,774–5 (called '*lalio*' in Verawal) = G. ? Nanking, *Meyen*, var. Roji, *Watt*, 152. . . . (Watt) nn. 1,733, 1,753, 1,772, 1,787, 1,788, 1,791, 1,837, 1,839, 1,884 = G. obtusifolium, *Roxb.*, 140; . . . (Watt) (Broach) 1,223, 1,878, 1,883, 1,889, 1,890, 1,895 (Surat) nn. 1,709, 1,715, 1,731–2, 1,876, 1,880–2 = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, race *Kahnami*, 150: . . . (Watt) nn. 1,716, 1,717, 1,724, 1,752, 1,830 = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, race *Goghari*, 150; . . . (Watt) nn. 1,738, 1,765, 1,805, 1,821 = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, race *Lalio*, 151; . . . (Burkill) n. 21,864 = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, race *Kumpta*, 151; . . . Madras collections, nn. C 1, C 5, C 8, C 15 = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, race *Uppam*, *Watt*, 151; . . . (Burkill) n. 21,870 = G. obtusifolium *Roxb.*, var. Wightiana, *Watt*, race Uppam, 151; . . . (Watt) nn. 1,759, 1,764, 1,801, 1,809, 1,812 = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, race *Kanvi*, 152; . . . (Burkill) n. 21,863 = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, race Kanvi, 152; . . . (Watt) nn. 1,747, 1,795, 1,822, 1,832, 1,845, 1,871 = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, race Wagria, 182; . . . (Burkill) nn. 21,872, 21,873, 21,868, 21,869 (black and white seeded *jowari hathi* = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, race *Tellapathi*, 153; . . . (Watt) n. 1,749 (ex herb. R. P. Mehta) = G. punctatum, *Sch. et Thon.*, 172; . . . (Watt) nn. 1,797, 13,819 = G. punctatum, *Sch. et*

Thon. var. nigeria, *Watt*, 172; . . . (Watt) **nn. 1,750, 1,781, 10,513, 12,876** = G. hirsutum, *Linn.*, 186; . . . (Burkill) **nn. 21,828, 22,011** = G. hirsutum, *Linn.*, 186; . . . (Watt) **nn. 1,804, 12,307, 12,320** = G. hirsutum, *Linn.*, var. religiosa, *Watt*, 202. . . . (Watt) **nn. 1,734, 1,814** = G. peruvianum, *Cav.*, 217; . . . (Watt) **n. 1,742** = G. mexicanum *Tod.*, 228; . . . (Watt) **nn. 1,777, 1,888** = G. purpurascens *Poir.*, 252.

R. E. P. collections are in Calcutta with some duplicates in Edinburgh and Kew.

Richie, Dr. Ch.: **nn. 59** and **59-2** (**Ahmedpur**) = G. Nanking, *Meyen*, var. Nadam, *Watt*, 129.

Riedel, Mr.: = G. Nanking, *Meyen*, var. Bani, *Watt*, 131; . . . (**Lotti** and **Lakor**, Malaya) = G. obtusifolium, *Roxb.*, 141.

Ritchie, Dr. D.: (**Belgaum**) = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, 145 (in Calc. herb.).

Rottler: **n. 330** (in Calc. herb.) = G. Nanking, *Meyen*, var. Nadam, *Watt*, 129; . . . (named 'G. mauritianum') = G. Nanking, *Meyen*, var. himalayana, *Watt*, 125; . . . (**Mysore**) = G. Nanking, *Meyen*, var. ? rubicunda, *Watt*, 126–7; . . . (**South India** named 'G. religiosum') = G. purpurascens, *Poir.*, 251; . . . (South India named 'G. vitifolium') = G. brasiliense, *Macf.*, 298.

Roxburgh, Dr. W.: (two specimens named 'G. hirsutum and herbaceum,' **ex Forsyth**) = G. arboreum, *Linn.*, var. neglecta, *Watt*, 98; . . . (specimen in **B. M.** with 'ex America introduced') = G. arboreum, *Linn.*, var. neglecta, *Watt*, 98.

Rowland, Dr. W.: **Lagos** = G. arboreum, *Linn.*, var. sanguinea, *Watt*, 92.

Royle, Dr. F.: **N.W. Ind.** (named 'G. barbadense') = G. purpurascens, *Poir.*, 251; . . . two specimens on sheet = G. arboreum, var. neglecta, *Watt*, and hybrid near G. Nanking, *Meyen*, 97; . . . (**N. W. Ind.**) = G. Nanking, *Meyen*, var. Bani, *Watt*, 131.

Rugel: **n. 92** (named 'G. racemosum' —**South Florida**) = G. punctatum, *Sch. et Thon.*, 170–1; . . . **n. 93** (**Key West**, Florida) = G. punctatum, *Sch. et Thon.*, 170–1; . . . (**North Carolina**, named 'G. herbaceum') = G. hirsutum, *Linn.*, 185; . . . **n. 93a** (**South Florida**) = G. barbadense, *Linn.*, 268.

Rusby: *see* **Britton**.

Russell: (Herb. Ind. Or.) = G. arboreum, *Linn.*, var. neglecta, *Watt*, 98.

Sagot, M.: **n. 1,263** (**French Guiana**) = G. brasiliense, *Macf.*, 298–9.

Saharanpur Herbarium: (1891) = G. Nanking, *Meyen*, var. Bani, *Watt*, 131; . . . (specimens named '**G. barbadense**') = G. hirsutum, *Linn.*, var. religiosa, *Watt*, 202.

Schimper, Dr. W.: (**Abyssinia**) **n. 691** = G. arboreum, *Linn.* (hybrid), 84; . . . **n. 1,025** = G. arboreum, *Linn.* var. ? sanguinea, *Watt*, 92; . . . **n. 691** = G. Nanking, *Meyen*, var. Roji, *Watt*, 135; . . . (in **Gay's** herb.) = G. barbadense, *Linn.*, 268.

Schimper and **Wiest**: (**Cephalonia**, named 'G. indicum') = G. herbaceum, *Linn.*, 158.

Schlagintweit: **n. 4,236** (**Kashmir**) = G. Nanking, *Meyen*, var. himalayana, *Watt*, 126; . . . **n. 11,244** (**Kach**) = G. obtusifolium, *Roxb.* var. Wightiana, *Watt*, 145.

Schmid, R.: (**Nilghiri** hills in Calc. herb.) = G. purpurascens, *Poir.*, 252.

Schomburgh, R.: **n. 239** (**Gosse Exped.**, Australia) = G. Sturtii, *F. v. M.*, 65.

Schott: **n. 602** (**Yucatan**) = G. Schottii, *Watt*, 207.

Schweinfurth, Dr. G. E.: (**Central Africa**) **n. 779** = G. Nanking, *Meyen*, 117; . . . **nn. 779, 941** (**Khartoum**) = G. Nanking, *Meyen*, var. Roji, *Watt*, 135; . . . **n. 1,607** (**Suakim**) = G. obtusifolium, *Roxb.* var. africana, *Watt*, 154; . . . **n. 527** (**Central Africa**) named 'G. vitifolium, *Cav.*' = G. mexicanum, *Tod.*, 228; . . . **n. 1,605** (**Nubische Kuste**, 1867) = G. purpurascens, *Poir.*, 251; . . . **n. 587** (**Central Africa**) = G. purpurascens, *Poir.*, 252; . . . **n. 186** (**Egypt**) = G. ? vitifolium, *Lamk.*, 258; . . . (**Damietta**, Egypt, 1888) = G. barbadense, *Linn.*, 268.

Scott, Dr.: (**Ceylon**) = G. vitifolium, *Lamk.*, 257.

Seemann, B. C.: **n. 28** (Nayatu, **Fiji**) = G. hirsutum, *Linn.*, var. religiosa, *Watt*, 201; . . . **nn. 31** and **32** (Fiji, peculiar races of) = G. peruvianum, *Cav.*, 215; . . . **nn. 29** and **30** (Fiji, named 'G. peruvianum, *Cav.*') = G. brasiliense, *Macf.*, 298.

Shuttleworth: (ex herb. cult. Algiers) = G. herbaceum, *Linn.*, 158; . . . (ex. herb.) (Rugel's **N. Carolina** 'G. herbaceum') = G. hirsutum, *Linn.*, 185.

Sinclair, Mrs.: = G. tomentosum, *Nutt.*, 70.

Sintenis, Paul (collections determined by Garcke): **n. 547** (**Porto Rico**) = G. purpurascens, *Poir.*, 251; (Porto Rico, named 'G. herbaceum') **n. 3,717** = G. purpurascens, *Poir.*, 251–2; . . . **n. 6,856** (Porto Rico) = G. ? barbadense, *Linn.*, 268; . . . **n. 362b** (Porto Rico) = G. brasiliense, *Macf.*, 299.

Sloane, Sir Hans, in British Museum: . . . **vol. 6, ff. 65 and 66** (Jamaica) = G. peruvianum, *Cav.*, 216; . . . (Plukenet) **vol. 56, f. 192** (King's Garden, Montpelier) = G. ? barbadense, *Linn.*, 269; . . . (Pluk.) **vol. 84, f. 87** and **85, f. 146** = leaves only of G. ? vitifolium, *Lamk.*, 258, 269, 270; . . . (Pluk.) **vol. 90, f. 38** (? India) = G. arboreum, *Linn.* (is not *Cuda Pariti* as stated to be), 84; . . . (Cuninghame ex Pluk.) **vol. 93, f. 185**—three specimens (a) = G. Nanking, *Meyen*, 116, (b) (*paretty*) = G. Nanking, *Meyen*, var. rubicunda, *Watt*, 127, and (c) = G. arboreum, *Linn.*, 84; . . . vol. **94, f. 102** = G. brasiliense, *Macf.*; . . . (Pluk.) **vol. 96**, f. 59 (? India) = G. arboreum, *Linn.*, (type, see Plate No. 7 A) 84; . . . (Pluk.) **vol. 96, f. 60** = t. 188, f. 2 = (Plate No. 49 B) = G. brasiliense, *Macf.*, 300; (Pluk.) **vol. 96, f. 62** (type of Pluk. t. 299, f. 1), also duplicate **vol. 100, f. 106**, see Plate No. 15 A) = G. ? Nanking, *Meyen*, 116; . . . (Pluk.) **vol. 100, f. 105** (type of species, see Plate No. 46 A and B) = G. barbadense, *Linn.*, 268–9; . . . (Pluk.) **vol. 100, f. 107** (? India) = G. arboreum, *Linn.*, 84; . . . (Beaufort, Mary Duchess) **vol. 132, f. 18** (two specimens) (a) leaves = G. ? vitifolium, *Lamk.*, 269, (b) (Barbados) = G. ? mexicanum, *Tod.*, 228; . . . (Beaufort) **vol. 133, f. 14** = G. hirsutum, *Linn.* (Plate No. 29 B), 184, 188; . . . (Beaufort) **vol. 135, f. 79** = G. brasiliense, *Macf.*; . . . (Petiver) **vol. 159, f. 205** is fragmentary (Virginia, coll. by Marshall) = G. ? vitifolium, *Lamk.*, 258; . . . (Petiver) **vol. 162, f. 289** (Jamaica) (Vaillant) = G. peruvianum, *Cav.*, 216; . . . **vol. 162, f. 290** = G. vitifolium, *Lamk.*; . . . (Petiver) **vol. 165, f. 212** (coll. by Camel) = G. arboreum, *Linn.*, 84, also on same page = G. brasiliense, *Macf.*; . . . (Petiver) **vol. 184, f. 28** (Barbados or Jamaica) = G. ? vitifolium *Lamk.*, 270; . . . (Miller) **vol. 228, f. 20** (grown at Chelsea) = G. arboreum, *Linn.*, var. neglecta, *Watt*, 98; . . . (Beaufort) **vol. 235, f. 35**—leaf only ? G. brasiliense, *Macf.*; . . . (Pluk.) **vol. 240, f. 39** (Camel's collection, 1700, Philippine Islands) = G. Nanking, *Meyen*, 116; . . . **vol. 290, f. 15** = G. vitifolium, *Lamk.*; . . . (Miller) **vol. 294, f. 45** (origin not stated) = G. herbaceum, *Linn.*, 158; . . . (Miller) **vol. 294, f. 45** (origin not stated, but grown at Chelsea, and is the type of the species) (Plate No. 29A) = G. hirsutum, *Linn.*, 184; . . . **vol. 311, f. 119** = G. ? mexicanum, *Tod.*; . . . (Boerhaave) **vol. 322, f. 100** = G. arboreum, *Linn.*, 84; . . . (Boerhaave) **vol. 322, f. 100** (grown in gardens) = G. vitifolium, *Lamk.*, 258; . . . (no specimen in herb. Plukthal = G. herbaceum, *Linn.*), 162.

Smith, C.: (**Otaheite**, 1791) = G. taitense, *Parl.*, 249.

Smith, J. G.: (seed from **Honolulu**) = G. tomentosum, *Nutt.*, 70.

Speke and **Grant**: (**Source of Nile**, 1860–3) = G. vitifolium, *Lamk.*, 258.

Spruce, R.: **n. 6,541** (**Chanduy**, N. Peru) = G. peruvianum, *Cav.*, 215–6; . . . (**Eucador**, 1857) = G. vitifolium, *Lamk.*, 258; . . . **n. 159** (**Para**) = G. brasiliense, *Macf.*, 298.

Stapf, Dr.: (**Persia**) = **hybrid** G. herbaceum, *Linn.*, × Nanking, *Meyen*, 158.

Steudner: **n. 115** (**Kordofan**) = G. purpurascens, *Poir.*, 251.

Stewart, Rev. J.: (**Zambesi**) = G. obtusifolium, *Roxb.*, var. africana, *Watt.*, 154; . . . (**Zanzibar**, 1862) = G. purpurascens, *Poir.*, 252.

Stocks, J. E.: **n. 469** (**Karachi**) = G. Stocksii, *M. Mast.*, 75; . . . (**Concan**) = G. brasiliense, *Macf.*, 298.

Structer: (**Florida**, 1853) = G. hirsutum, *Linn.*, var. religiosa, *Watt.*, 202.

Sturt, McDougal: **n. 235** (**Australia**, 1839) = G. Sturtii, *F. v. M.*, 65.

Sturt, D.: **n. 20** (**Barrier Range, Australia**) = G. Sturtii, *F. v. M.*, 65.

Swinhoe, R.: (**Hainan**) = G. purpurascens, *Poir.*, 251.

Thomas, E.: (**Cagliari, Sardinia**, 1836) = G. hirsutum, *Linn.*, 186.

Thomson, G.: (**Palaveram**, Madras, 1845) = G. Nanking, *Meyen*, var. rubicunda, *Watt.*, 126; . . . (**Madras**, 1845) = G. mexicanum, *Tod.*, 228; . . . Herb. Ind. Or. n. 421 (in Calc. Herb.) = G. mexicanum, *Tod.*, 228.

Thomson, T.: (**Sikkim** specimen in Calc. herb.) = G. arboreum, *Linn.*, ? nov. var. or hybrid neglecta × assamica; . . . (**Kashmir** and Lahore, 1846) = G. Nanking, *Meyen*, var. himalayana, *Watt.*, 125; . . . (**Saharanpur**) = G. hirsutum, *Linn.*, 185 (see also under Hooker and Thomson).

Thonning: (**Guinea**) = G. hirsutum, *Linn.*, var. religiosa, *Watt.*, 202.

Thurn, E. F. im: **n. 79** (**British Guiana**) = G. peruvianum, *Cav.*, 216.

Tonduz: **n. 13,484** (**Costa Rica**) = G. punctatum, *Sch. et Thon.*, 170.

Tranquebar, South India, Cottons obtained from G. arboreum, var. neglecta, *Watt*, 96, 101; G. purpurascens, *Poir.*, 252.

Tronqueville: **n. 266** (**Abyssinia**) = G. mexicanum, *Tod.*, 228.

Triana, J. J.: **n. 3,138/5,286** (**New Granada**) = G. peruvianum, *Cav.*, 216.

Tweedie: (**Argentine**, 1837) = G. vitifolium, *Lamk.*, 258.

Vachell, Rev. G. H.: (**Macao**, 18,301) = G. Nanking, *Meyen*, 117; . . . **n. 285** (ex herb. Lindley) = G. Nanking, *Meyen*, 117.

Vaillant, M. (contributed a specimen to **Petiver**), 216.

Veitch's collectors (**Savage Islands**) = G. brasiliense, *Macf.*, 298; . . . (**N. Borneo**) = G. brasiliense, *Macf.*, 299.

Vidal: **n. 2,184** (Ticas, **Philippines**) = G. obtusifolium, *Roxb.*, 141; . . . **n. 2,183** (Wild Gapas in Philippines = G. microcarpum, *Tod.*, 211; **n. 2,185** (**Maibung Salu**, Philippines wild cotton) = G. taitense, *Parl.*, 249.

Vieillard: **n. 130** (**New Caledonia**) = G. purpurascens, *Poir.*, 252.

Vogel, Dr. E.: **n. 35** (**Central Africa**, Kouku) = G. punctatum, *Sch. et Thon.*, 171; . . . **n. 35** (Central Africa) = G. mexicanum (hybrid) *Tod.*, 228; . . . **n. 20** (**Fernando Po**) = G. brasiliense. *Macf.*, 298.

Wade, Capt., (seeds of **Kabul** Cotton supplied Calc. Bot. Gard.), 127.

Wallichian collections discussed on the basis of the set preserved by the Linnean Society, London, the corresponding specimens in other herbaria being often given within square brackets:—

. . . **n. 1875 'A'** named 'G. vitifolium' ex Wight, coll. **Madras**, 1826 = G. purpurascens, *Poir.*, 252 [duplicate in Calc., 252], [specimen in Kew seems = G. mexicanum, *Tod.*, 228]; . . . **1,875 'B'** named 'G. latifolium' ex Russell = G. purpurascens, *Poir.* [non G. latifolium, *Murray*, which see page 183]; . . . **1,875 'C'** named 'G. herbaceum' ex Heyne = G. punctatum, *Sch. et Thon.*; [**n. 1,875** in Calc. and Kew, ex Heyne = G. purpurascens, *Poir.*, 252]; . . . **1,875, 'D'** marked 'H. B. C.' = G. purpurascens, *Poir.*; . . . **1,875 'E'** named 'Gossypium, **Penang**' collected in 1822 = G. mexicanum, *Tod.*; . . . **1,875 'F'** named 'ex herb., Wight' = G. peruvianum, *Cav.*; [specimen in Calc. named 'G. arboreum' and said to be ex herb. **Mad.**, 216]; . . . **1,875 'G'**

named 'G. nigrum, vitifolium, *Roxb.*, ex Ham. collected Botanical Gardens, Calcutta, Dec. 28, 1814 = G. hirsutum, *Linn.*, var. ? religiosa, *Watt*; . . . **1,875 'H'** named 'G. nigrum laeve' ex Ham. n. 1,550, collected **Sibgunj** Nov. 21, 1809 = G. purpurascens, *Poir.*; [in Edinburgh Herb., p. 252]; . . . **1,875 'J'** named 'G. nigrum, var. rubicundum,' ex Ham. collected **Gonga Chora**, June 30, 1809 = G. arboreum, *Linn.*, var. ? sanguinea (or rather red-flowered var. neglecta, *Watt*; [in Edinburgh Herb., p. 93]; . . . **1,875 'K'** in Wall. Cat. named 'G. flavescens' and obtained from Herb. **Mad.**, but there is no specimen of it in Linnean Society's set; [though in Calc. dated Nov., 1807, collected Mad. = G. vitifolium, *Lamk.*, p. 258]; . . . **1,875 'L'** in Wall. Cat. named 'G. arboreum' and procured from Herb. Mad.—no specimen in Linnean Society's set [in Calc. set there is a specimen mentioned under 'F' above that answers to this = G. peruvianum, *Cav.*, 216]; . . . **1,875 'M'** named G. flore albo,' &c. = G. mexicanum, *Tod.*, but has alongside a fruit with very large seeds coated with thick rust-coloured fuzz and poor rust-coloured floss: on the same sheet are also mounted two other plants ex Wight, collected at **Tanjore** in 1813. These are (*a*) named 'G. hirsutum, var. ?' = G. punctatum, *Sch. et Thon.*; (*b*) named 'Cudaparatti, Tamil' = G. barbadense, *Linn.*

. . . **1,880 'A,'** n. 559, named 'G. herbaceum,' collected **Kyang Talong**, Martaban, Sept. 1826 = G. Nanking, *Meyen*, var. ? Nadam, *Watt*; . . . **1,880 'B,'** named 'G. herbaceum' = G. Nanking, *Meyen*, var. rubicunda, *Watt*; [this exactly matches the 'H.B.C.' specimens in Calc. Herb. and has distinctly purple flowers, 141]: on the same sheet is mounted another plant, named 'G. indicum,' ex Wight, collected **Tinnevelly** 1814 = G. Nanking, *Meyen*, var. Nadam, *Watt*; [in Kew Herb., see Wight's **Tinnevelly** plant, 129]; . . . **1,880 'C,'** named 'G. viridescens hirsutum' ex Ham., collected **Nathpur**, Sept. 1810 = G. arboreum, *Linn.*, var. neglecta, *Watt*; [often quoted as **1880** (a) whereas it should be **1880 C** (a): duplicates in Calcutta and Edinburgh], 94, 99; on the same sheet is a second plant named 'G. viridescens herbaceum,' ex Ham., collected **Nathpur**, Oct. 1810 = G. arboreum, *Linn.*, var. neglecta, *Watt*, but possibly hybridised with G. Nanking, *Meyen*—is much like a form of var. Bani, *Watt*; [often quoted as **1880** (b)], 94, 99; . . . **1,880 'D,'** a cultivated cotton collected above **Trogla**, March 1847 = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*. . . . **1,881 'A,'** named 'G. arboreum,' also 'G. religiosum,' ex Heyne = G. arboreum, *Linn*, 82, 84; . . . **1,881 'B,'** said in Wall. Cat. to have been obtained from herb. Russell, but no specimen of it in the Wall. Herb., in possession of Linnean Society; [in Kew Herb. it may however be seen] = G. arboreum, *Linn.*, var. neglecta, *Watt*, 98.

Wallichian (so-called) specimens not represented in Linnean Society's set [n. **1,875**, in Calc., ex Heyne] = G. Nanking, *Meyen*, var. Bani, *Watt*; . . . [n. **1,875**, in Calc., ex **Mad.** Herb.] = G. ? mexicanum, *Tod.*; . . . [n. **1,875**, in B. M. Herb. coll. **Bhutan**] = G. purpurascens, *Poir.*, 252; . . . [**1,881 a**, in B. M. Herb., ex herb. Shuttleworth] = G. Nanking, *Meyen*, var. Bani, *Watt*, 132; . . . [**1,881** in Calc., ex herb. Heyne] = G. Nanking, *Meyen*, var. near Roji, *Watt*.

There are several significant features of the Wallichian cottons: for example the absence of G. brasiliense; the existence of only one of G. obtusifolium, *Roxb.*, var. Wightiana, and the absence of G. obtusifolium, *Roxb.* (proper). On the other hand there is an extensive series of G. purpurascens, *Poir.*, and G. mexicanum, *Tod.*, often hardly separable, since neither fruits nor seeds are as a rule present. Lastly, only one sample of G. hirsutum, *Linn.*, exists in the series. The major portion of the specimens in Wall. Cat.

were derived from Hamilton or Wight—the last being indicative of the early experiments at acclimatisation of foreign cottons in India.

Walsh, J. J.: (**St. Lucia**, W. Indies), named 'G. barbadense, var. integra, *Griseb.*') = G. peruvianum, *Cav.*, 216.

Warnecke: **n. 18** (**Togo-land**) = G. peruvianum, *Cav.*, 215.

Watson, S.: **n. 29** (**Guatemala**) = G. brasiliense, *Macf.*, 298.

Watt: (see **R.E.P.**).

Webb, R.: (**Nyassaland**, *Kota-Kota*) = G. punctatum, *Sch. et Thon.*, 171; . . . specimen in **Florence** Herb. = G. lanceolatum, *Tod.*, 210.

Wellby, Capt. W. H.: (**Lake Rudolf**) = G. punctatum, *Sch. et Thon.*, 171.

Welwitsch, Dr. F.: **n. 5,222** (Angola named 'G. maritimum, *Tod.*') = G. punctatum, *Sch. et Thon.*, 171; . . . **n. 5,224** (not indigenous in **Sange**) = G. punctatum, *Sch. et Thon.*, 171; . . . **n. 5,229** (**Angola**—Kew specimen) = G. microcarpum, *Tod.*, 211; . . . **nn. 5,235, 5,222** = G. mexicanum, *Tod.*, 228; . . . **nn. 5,223, 5,226** and **5,235** (B.M. specimen — **Angola**) = G. purpurascens, *Poir.*, 252; . . . **nn. 5,229** (B.M. specimen) **5,230, 5,232** (**Angola**) = G. barbadense, *Linn.*, 268; . . . **nn. 5,228, 5,230** (Kew set) = G. brasiliense, *Macf.*, 298; . . . **nn. 5,227, 5,228, 5,231, 5,233, 5,234** (B.M. sets) = G. brasiliense, *Macf.*, 299.

Whyte, A.: (**Lama** and **Witu**, N. Mombassa) = G. Kirkii, *M. Mast.*, 317.

Wight, R.: . . . **n. 176** named 'G. album' (in Kew, Edinburgh, Geneva) = G. arboreum, *Linn.*, 83-4; . . . **n. 177** (type in Glasgow herb., also Wight, Illus. No. 27; also in Edinburgh) = G. brasiliense, *Macf.*, 298-9; . . . **n. 177** (in Br. Mus. Herb.) = G. brasiliense, × peruvianum hybrid, 299; . . . **n. 178** (in B.M. Herb.) = Nanking, *Meyen*, var. Bani, *Watt*, 132; . . . **n. 178** (in DC. Herb. Geneva) = G. Nanking, *Meyen*, ? var. rubicunda, *Watt*, 127; . . . **n. 179** (in Edin. Herb. ex Greville) named 'G. nigrum, Ham.' = G. arboreum, *Linn.*, 84; . . . **n. 179** (in DC. Herb. Geneva) = G. arboreum, *Linn.*, var. neglecta, *Watt*, 98; . . . **n. 180** named 'G. nigrum, Ham.' (in Glasgow Herb. and B.M., also in Cambridge ex Herb. Henslow) = G. mexicanum, *Tod.*, 228; . . . **180** (in Kew Herb.) = G. purpurascens, *Poir.*, 251; . . . **n. 212** (**Coimbatore**) = G. arboreum, *Linn.*, var. rosea, *Watt*, 112; . . . **n. 213** (in Calc. Herb.) = G. mexicanum, *Tod.*, 228; . . . **n. 214** (in Kew) named 'G. herbaceum' = hybrid of G. arboreum, *Linn.*, 84; . . . **n. 214** (Pen. Ind. Or.) = G. Nanking, *Meyen*, var. Nadam, *Watt*, 129; . . . (in Cambridge Herb. ex Lindley) from **Coimbatore** = G. arboreum, *Linn.*, var. sanguinea, *Watt*, 93; . . . (from Coimbatore) named 'G. religiosum' = G. purpurascens, *Poir.*, 252.

Wilkinson: (Wild cotton of **Egypt**) = G. obtusifolium, *Roxb.*, var. africana, *Watt*, 154.

Wilkinson: (**Egypt**) in B.M. 1834 = G. barbadense, *Linn.*, 268.

Winterbottom, J. E.: **n. 981** (**Gilgit**) 1827 = G. herbaceum, *Linn.*, 158.

Wood, Capt., specimen of *G. Klotzschianum*, *Andss.*, 67.

Wright, Dr.: (ex herb. Balfour) = G. arboreum, *Linn.*, var. neglecta, *Watt*, 98.

Wright, C.: (**Cuba**) = G. punctatum, *Sch. et Thon.*, 170.

Wright, W.: **n. 40** (**Jamaica**) = G. peruvianum, *Cav.*, 216.

Zimmermann: **n. 131** = G. arboreum, *Linn.*, var. sanguinea, *Watt*, 93.

Zollinger: (**Java**) (in DC. Herb. Geneva) = G. arboreum, *Linn.*, 84; . . . **n. 153** (in DC. Herb. Geneva) = G. Nanking, *Meyen*, var. Bani, *Watt*, 132; . . . **n. 3,562** (in Kew Herb.) = G. hirsutum, *Linn.*, 185; . . . (in DC. Herb. Geneva) = G. peruvianum, *Cav.*, 217; . . . **n. 210** (in DC. Herb. Geneva) = G. purpurascens, *Poir.*, 252; . . . **Japan** = G. brasiliense, *Macf.*, 298.

APPENDIX B

Enumeration of the Chief AUTHORS Consulted while Writing the 'Cottons of the World'

The titles, dates and pages of the books, reports or papers are given within square brackets, then follow figures to denote the pages, if any, of this Work where direct references have been made to the authors in question; notes regarding books are given within circular brackets.

Abbeville, Claud d': [Hist. do Maranhao, 1612–14 A.D., 356], 296.

Abdollatiph: (Arab physician in Egypt 1200 A.D.—List of Pl. by), 14, 86.

Abul Fazil: [Ain-i-Akbari, 1590–94, 617], 14.

Abul Jouan: (Speaks of cotton in the Gardens of Hyères in 1566 A.D.), 159.

Abu Zacaria Ebn el Awam: [Banqueri's transl. II., ch. 22, 103], 15.

Abu Zaidu-l Hasan [of Siraf, 916 A.D.] *see under* Sulaiman.

Acosta, Joseph de: [1518, Hist. Ind. Fr. transl., 1598, 175], 304.

Adler & Casanowicz: [Biblical Antiq. in Ann. Rept. Smithsonian Inst., 1896, 1005], 15.

Ægineta, Paulus: [Adams transl. 1847, III., 464].

Africanus—*see* Leo.

Agriculture: [Reports—Director of Bombay, 1900–01, 24], 128.

Agric.-Hort. Soc. India, Journ.: [Report on importation of American exports into India, 1839].

Al Biruni: (Arab writer 970–1039 A.D.), *see* Rashiduddin.

Aliotta, Dr. Angelo: [Riv. Crit. Gen. Goss. 1903], 64, 74, 82, 96, 112, 114, 139, 143, 146, 156, 183, 201, 210, 248, 256, 266, 274, 275, 296, 331–2.

Alpinus, Prosper: [De Pl. Ægypti., 1592, 29; Vesling ed. 1640, 69–71, t. 71], 15, 81, 83, 86, 159; also [De Pl. Exot. 1627].

Aluarez, Don Francisco: (mentioned by Pory in transl. Leone Africanus, I. 22, discusses Abyssinian cotton 1520), 173.

Ambrosinus: [Phytologia, 1666, I., 106], 11, 59–60.

Amyot: [Memoirs, II., 606], 136.

Andersson: [Enun. Pl. Insul. Galapag. in Kongl. Vet. Akad. Handl., 1853, LXXIV., 228], 66.

Arnold, Col. A. J.: (Inspec. Gnal. de Explor. Companhia de Moçambique) [Memo. &c., 1905], 197, 293

Arrian: [Indika, 150 A.D., McCrindle's transl., 219], 11, 12.

Atkins, John C.: [Secretary Br. Cotton-Growing Assoc. — numerous reports] 179, 198, 285.

Aublet: [Hist. des Plantes La Guiane Françoise, 1785, 705], 271.

Auckland, Lord: [Minute, 1839], 149.

Azara: [Voyages, 1781–1801, article by Tadeo Haenke (in App. to vol. II.)], 304, 314.

Baber, Emperor: [Memoirs, 1519–26, 326, 395, &c.].

Baines: [Hist. Cotton Manuf. of Gt. Brit., 1835], 160, 239.

Bajon, M.: [Mem. pour servir à l'histoire de Cayenne et de la Guiane Française, 1777], 305.

Ball, V.: [Animals & Plants known to early Greek authors—see Royal Irish Acad. 1884, 339].

Barbosa: [Travels in East Africa and Malabar, transl. by Stanley, Hakl. Soc., 5, 13, &c., 1516 A.D.], 17.

Baron, Rev. R.: [Fl. Madag. in Journ. Linn. Soc. XXV., 1890, 246–94], 293.

Barrow, J.: [Travels in China, 1806, 2nd ed. VIII., 566, 560], 118.

Bary, Dr. A. de: [Compar. Anat. of Veg. et Organs. Engl. ed. 1884, 201–10], 56.

Bateson, W.: [Address New York Hybrid Conference], 342.

Bauer, F.: *see* Thomson, James.

Bauhin, C.: [Pinax, Theat. Bot., 1623, 430], 155.

Bauhin, J.: [Hist. Pl. 1648, I., 74, 343–47], 155.

Baxendale, A. S.: [Bull. Straits & Fed. Mal. States, II., 1903, 345–9], 294.

Beauchamp: [Hist. Brazil, 1500, vol. I., 93, 96], 17.

Beaufort: [Cotton Production & Trade of Ind., 1903; also Journ. Soc. Arts, July 1904], 149.

Bebb, John: [Quality & Uses of Dacca Cotton in E. I. Company's collection, Reports, &c. published 1836, 350–72], 103, 106.

Beckmann: [Vorber. Waarenk. I., 1793].

Beechey: [Voy. (Bot. by Hook. & Arnott) 1841, 60, 79, 411], 168, 255.

Belon: [Plurim, Singu. Rer. in Græcia Observ., 1589, Bk. II., 295], 86.

Bentham & Hooker: [Gen. Pl. I., 196–9, 209], 4, 53, 54.

Bentham & Mueller: [Fl. Austr. I., 222], 63.

Bent, J. Th. & Mrs.: [Southern Arabia, 1900, 141, 431, (speaks of cotton as abundant in a wild state —see Appendix A) — Hadramaut Exped. 1895–7], 75, 135.

[**Berichte** über Land und Forstw. in Deutsch-Ostaf. I., 1903, 195], 181.

Bertoloni: [Miscellanea Botanica, VI., 1847, 10–11].

Blackman, Leo. G.: [Fibres of Hawaiian Islands, 1903, 45–6].

Blume: [Bijdr. Fl. Neder. Indie, 1825, 74–5].

[**Board of Trade Jour.** Oct., 1901; June, 1903; Aug., Nov., Dec., 1903; Jan., Sept., 1904], 181. . . . [November 1904], 197.

Boerhaave: [Index Pl. Hort. Acad. Lugd.-Batav., 1720, I., 173–4], 81, 156.

Bolingbroke: [Voy. to Demerary, 1807, 204], 307.

Bombay Chamber of Comm.: [Ann. Rept. 1900], 128.

Bontius: [Mant. (apud Pison., Hist. Nat. VI., 105)].

Botanical Register: [1815, t. 84], 255.

Bouteron: [Le Coton d'Egypte, Brussels, 1895], 226.

Bovell: [West Ind. Bull., vol. VI., 1905], 239. *See also* Morris & Bovell.

Bowman, Dr. F. H.: [Structure of the Cotton Fibre, 1882], 25, 31–4, 40.

Brandegee, T.: [Pl. of Baja Calif. in Calif. Acad. Science, 2nd ser. II., 136–7], 73.

Brandes: [Der Baumw. in Alterthum, 1880].

Branner, J. C.: [Cotton in the Empire of Brazil, U.S.A., Dept. Agri. Misc. No. 8, 1885], 183, 256, 296, 304, 308.

Bretschneider: [Study and Value, &c., 1870, 7; . . . Hist. Europ. Bot. Disc. in China, 1898, 400; . . . Bot. Sin. 3 vols., 1882], 13, 116, 121.

Brewer & Watson: [Bot. Calif., 1876, I., 82], 65, 66.

Breyne, Jacob: [Prod. Rar. Pl., 1739, I., 24], 300.

Briggs: [The Cotton Trade of Ind. in Royal As. Soc., 1839, 1–88], 149.

Brooks, C. P.: [Cotton, Its Uses, &c., 1898], 239.

Browne, Patrick: [Hist. Jam. 1789, 282–3].

Bulletin: [Du Ministère de l'Agriculture of France], 312.

Bulletin: [Imp. Inst. II., 1904; II., 1905], 181.

Burbidge: [Propag. and Improv. of Cult. Pl., 388], 336.

Burkett & Poe: [Cotton, 1906, 82, 86–92], 36, 192, 230, 239.

Burkill, I. H.: [Mem. Dept. Agri. in Ind. I., No. 4], 117.

Burlamaqui: [Monogr. do Algodoeiro, 13], 308.

Burmann, N. L.: [Thes. Zeyl., 1736], 140; . . . [Fl. Ind., 1768, 150], 82, 96.

Burns, Alex.: [Rept. Chamber Com. Bombay on improved Broach Cotton, 1844], 89, 335.

Burton: [First Footsteps in E. Africa, 1894, I., XXVI., II., 175], 311.

Camara, Arruda da: [Memoria sobre a Cult. dos Algodo. ch. I.]

Camerarius—*see under* Matthiolus.

Candolle, A. de: [Bot. Geogr. 1855, II., 971–6], 156; . . . [Origin of Cult. Pl., Engl. ed. 1884, 402–11], 4; . . .

[Prod., 1824, I., 456–7], 82, 143, 183, 250, 255, 265.

Cannon, W. A.: [Spermatogenesis of Hybrid Cotton, in Bull. Torry Bot. Club, xxx., 1903], 286, 339; . . . [Cytological Aspects of Hybrids], 286, 339.

Carder—*see under* Purchas.

Carroll: [Hist. S. Carolina], 19.

Cassels, W.: [Cotton in Bomb. Pres. 1862], 149.

Cavanilles, Ant.: [Diss., 1785–90, 309–15; . . . Icones, tt. 164–9], 82, 100, 114, 156, 189, 190, 201, 203, 213, 214, 255, 261, 265, 295; . . . [Lecciones, 1827, 522–3], 201.

Celsius: [Hierob., II., 157].

Chapman, I.: [The Cotton and Commerce of India, 1851], 149.

Chilton, John—*see* Hakluyt.

Christy: [Cotton is King, 1856], 239.

Cibot, P. M.: [Mem. Conc. les Chinois, II., 603], 118.

Clarke, Major Trevor: [Official Repts. on his experiments in hybridisation of cottons], 133, 191, 336–9.

Clavigero: [Hist. Mex. 1731–87], 17.

Collingwood: [Rambles of Naturalist, 1868, 266].

Cooke, Dr. T.: [Fl. Bomb. Pres. I., 115, 1901], 73.

Cook, O. F.: [United States Dept. Agri. Rept. No. 78, also Bull. Entom. No. 49], 58–9; . . . [Weevil-resisting Adaptations Cotton Plant, United States Dept. Agri. Bull. No. 88 of 1906], 58, 162, 208, 213, 214, 241, 242, 256, 296, 319.

Comstock, J. H.: [Rept. on Cotton Insects, 327], 58.

Cortes: [Allgemeine Hist. der Reisen, bk. XIII., 1755] (discovered cotton in Mexico, 1519), 17.

Crawford, J. M.: [The Indust. of Russia, III., 1893, 143–9], 239.

Crawfurd: [Journ. to Siam &c., 1830, II., 180], 120; . . . [Journ. to Ava, 1834, II., 194–8].

Cross & Bevan: [Paper-making, 1900, 95–6], 38–9; . . . Cross, Bevan, King & Watt: [The Ind. Fibres & Fib. Substances, pub. by E. & F. N. Spon, London, 1887], 37.

Crum, Walter: (Drawings of cotton cells or hairs, 1863, *see* Bowman), 25.

Curzon, Lord: [Persia and the Persian Question, I., 1892, 496–7], 126.

Dabney, Dr. C. W.: [The Cotton Plant, U.S. Dept. Agri. Bull. No. 33, 1896], 23, 192, 239.

Dalzell & Gibson: [Bomb. Fl. 1861, 21], 74.

Dampier: [Voyages, 1679–61, I., 384, 426–7; II., 42; III., 46], 118.

Darlington, Dr. W.: [Agri. Bot. Philadelphia, 1847, 17], 156.

Darrah, H. Z.: [Note on Cotton in Assam, 1887], 108, 109, 110.

Darwin: [Cross & Self Fertilisation, 403–4], 58; . . . [Voyage of the Beagle, 1831–6], 69, (reversion) 111, (slight variations), 331.

Daubeney: [Lectures on Roman Husbandry, 1857], 16.

Davis Johan: [Travels to E. Indies, 1598–1604, 29].

DeCoin, Col. R.: [Hist. & Cult. of Cotton & Tobacco, London, 1864].

Delile: [Fl. Egypt Illust., 1812, 24], 154.

Delpino: [Rapporti tra insetti e tra nettari estranuziali], 58.

Denis: [Hist. Brazil, 67], 308.

De Quiqueron de Beaujeu: [De Laudibus Provinciæ, 1539], 159.

Descourtilz: [Fl. des Antilles, 1827, IV., 269, t. 278], 265, 311.

De Souza: [Hist. Brazil, ed. 1851, 202], 17.

De Vica: (Discovered wild cotton in Texas in 1536), 17.

De Vries, Hugo: [Die Mutations theorie, vol. I., 431]; . . . [Species and Varieties, Their Origin by Mutation (Ed. by D. T. MacDougal, 1906, 725)], 208, 229–30, 296, 309, 331.

Dewey, Lyster H.: (Trade names of Cottons), 47; . . . (Indian & Japanese Cottons), 123–4; . . . (Remarks on Uplands), 194–6, 227–38; . . . (On Sea Island), 277.

Dioscorides: (Makes no mention of Cotton), 16.

Diplomatic & Consular Reports: [No. 606, Misc. series, Apr. 1904, also No. 3,312, 1903], 181, 197.

Dobson, B. A.: [Humidity in Cotton Spinning, 1894], 29, 37.

Dodge: [Useful Fiber Plants of the World, 1897, 174–86], 239.

Dodonæus: [Stirp. Hist., 1558, 66; also ed. 1616, III., 65].

Don, George: [Hist. Dichl. Pl., 1831, I., 486–7].

Donnell, E. J.: [Hist. Cotton, New York, 1872], 201, 239, 254, 276.
Duggar, Prof.: (Classification of Cottons), 230, 238.
Dunstan, Prof. W. R.: [Mem. Cotton Cult., 1904, 10], 222.
Du Halde: [Gen. Hist. China, Engl. transl. I., 1736, 19], 118.
Du Prate: (Speaks of the Cotton of Louisiana in 1758), 19.
Duthie & Fuller: [Field & Garden Crops, 1882–3, I., 75], 95, 96.

East India Company: [Reports, &c. on Culture & Manufacture of Cotton, 1836, 1–431], 103, 254.
Eben-el-Awan of Seville: (Twelfth Century writer), 158.
Eckardt, W. R.: [Territorial Limitations of Cotton, Supp. Tropenpflanzer, VII., Feb. 1906].
Edgeworth, M. P.: [Pollen, 1879], 349.
Edwards: [Hist. Br. Col. Jamaica, 1793, II., 268], 183, 189, 213, 250, 254, 295.
Ehret: [New & Rare Plants—MS. in B.M., also water colourings], 187, 260.
Elliot, Sir Walter: [Fl. And. (giving Indian vern. names for G. brasiliense)], 296.
Engler & Prantl: [Pflanzenfam., III., No. 6, 1895, 51–3], 96, 156, 183, 266.
Eratosthenes: [apud Strabo, XV., t. 13, 690], 12.
Evans, Dr.: [The Cotton Plant,—Botany of—in U.S. Bull. No. 33 of 1896], 36, 266, 273, 275.

Fitch, Ralph: [Travels in India, 1583], 14.
Flatters, A.: [The Cotton Plant, 1906].
Fitzgerald, W. W. A.: [Travels in Br. East Africa, 1898, 147], 311, 312.
Foaden, G. F.: [Journal of the Khedivial Agri. Soc. V., 133–78], 280; . . . [Notes on Egyptian Agri.—in U.S. Dept. Agri. Bull. No. 62, 1904, 7–42], 219, 278, 280, 313.
Forskal: [Fl. Ægypt-Arab., 1775, 125], 15, 82, 84, 156, 161.
Fortune: [Three Years' Wanderings in N. China, 1847, 264], 118; . . . [Tea Countries of China, 1853]; . . . [A Residence amongst the Chinese, 1853–6]; . . . [China & Japan, 1863].
Fuchsius: [Pl. Hist. 1549, ch. 222]; . . . [Hist. Stirp., 1551, 529]; . . . [Hist. Stirp., 1542, p. & t. 580–1], 155, 159, 161.

Gærtner: [Fruct. et Sem. II., 1791, 246, t. 134].
Gammie, Prof. G. A.: [Note on Classification of Indian Cottons & Cross-breeding Exper. at the Poona Farm, 1901–3], 76, 96, 111, 112, 134; . . . [The Indian Cottons, 1905, p. 8], 74, 76, 82, 112, 128, 183, 332.
Gay: [Flor. Chilena, 1845, I., 312].
Gerarde: [Herbal, 1597, 753; also ed. 1636, 901], 85, 160.
Gibbs, J.: [Cotton Cultivation in its Various Details, London, 1862].
Glover: [Agri. Rept. 1855, 234], 58.
Gollan: [Rept. Saharanpur Gardens; experiments with Bani & Assam Cotton], 110.
Graham: [Cat. Pl. Bomb., 1839, 15], 134.
Gray, Asa: [in Bot. Explor. Exped. under Wilkes, 1854, 179], 69; . . . [Scientific Papers selected by Sargent, 1889, makes no mention of Cotton].
Greenway, G.: [Manchester Chamber of Commerce Monthly Record, Sept., 30, 1903], 106.
Grisebach: [Fl. British W. Indies, 1864, 86], 265, 267, 271.
Guillemin, Perrottet & Richard: [Fl. Senegamb. Teutam., I., 62–3, III., 263, 1830], 168.

Haas, Dr. K. W. Tromp de: [Review of the Introduction of the Cotton Industry in the Netherlands, India, in Bull. Straits, &c., III., 1903, 195–232], 294.
Hakluyt: [Voy. & Traffiq., 1809–12, III., 553, also IV., 195, 207, 1809, 213], 16, 303–4. *See also* Martyr.
Hamilton, Dr. F. Buchanan: [Journey through Mysore, Canara, &c., 1807]; . . . [Account of Nepal, 1819]; . . . [Comm. on Rheede Hort. Mal. in Trans. Linn. Soc. XIII., 1822, 491–4], 99, 201; . . . [Stat. Acc. of Dinajpur, 1833, 199–

200]; . . . [Life of, by Col. D. Prain, in the Ann. Royal Bot. Gard. Calc., 105].
Hanausek: [Tech. Mikroskopie, 1900, 5–8], 33.
Hannan: [Textile Fibres of Commerce, 1902, 89], 37, 45.
Harcourt—*see* Purchas.
Hasskarl: [Cat. Hort. Bot., 200], 91–2
Hawaiian: [Forester & Agri., vol. I., 1904], 294.
Hawks: [in Hakluyt Voy. &c., 1572, III., 553], 304.
Heckel, M. le Prof. E.: [Ann. L'Instit. Colon. de Marseille, 78].
Hemsley: [Biol. Centrali-Americana, 1879–88, I., 123], 265.
Henderson & Hume: [Lahore to Yarkand, 1873, 314–5], 114.
Henry, M. Yves: [French West Africa in L'Agri. Prat. des pays chauds, II., 1902–03, 551–85, 703–24; III., 46–55, 181–204, 308–41, 441–62, 596–611, 718–46; IV., 80–93, 235–46; V., 431–37], 169, 177.
Herbert: [Travels &c., 1677, 365].
Hernandez: [Nov. Pl. Hist. 1651, 308], 192, 210, 255.
Herodotus: [Hist. Bk. III., ch. 47, 106, &c., 450 B.C.], 10.
Heuzé: [Le Pl. Ind. I., 140–4, 1893], 156, 159, 183, 184, 266, 296.
Hillebrand: [Fl. Hawaiian Islands, 1888, 50], 69, 71, 248.
Hill: [Veget.-Syst., 1769, xv., 19], 96.
Hochreutiner: [Revis. Gen. Hibiscus, in Ann. du Conserv. du Jard. Bot. de Genève, 1900, 23–191], 55.
Hooker, Sir J. D.: [Linnean Soc. Trans. xx., 1847, 231].
Hooker & Arnott: [Fl. of Beechey's Voy.—Society Islands—1841, 411], 168, 255.
Hooker & Bentham: [Fl. Nigritiana—in Niger Fl., 1849, 229], 169.
Hooker & Webb: [Pl. Cape de Verd Islands—in Niger Fl., 1849, 107], 169.
Hove, Dr.: [Tour, Scientific &c. Research, in Gujarat, Kathiawar and Konkan, 1787—numerous passages]. *See also* General Index.
Humboldt: [Ess. Pol. Nor.-Expan., in Voyages Humb. et Bonpl., Pt. III., 1811, 433–4].
Hughes, Rev. G.: [Nat. Hist. Barbados, 1750, 191].
Hunt, Roger: [Observ. Braz. Cotton, 1808, pub. in vol., Reports & Documents, &c., by E. Ind. Coy., 1836, 372–81], 314; . . . [also in same vol., Culture of Cotton in Africa, pp. 379–84].
Hutton, J. A.: [The Cotton Crisis—a paper read before the Br. Assoc., Cambridge, 1904]; . . . [Address to Planters in Barbados, 1907], 291.

Iban Hanifa: (Arab writer—quoted by Serapion, *which see*), 13.
Indian Museum Calcutta: [Reports of Ann. 1893–94, 2–5], 148.
[**Institutes of Manu**], 10.
Isert: [Reise nach Guinea, Kopenhagen, 1788], 255.

Jacquin: [Eclogæ Pl. Rar., 1844, II. 7, t. 134], 91.
John, M.: (sent cotton from Tranquebar, in Madras, to Rohr), 101.
Jonston: [Dendrog., II., Arbor. Nucif., 1662, 132], 155, 159.
Joret: [Les Pl. dans l'Antiq. et au Moyen Age, 1897, 43–4], 157.
Jumelle: [Cult. Colon. (Pl. Indust.), 1901, 1–27, and two plates], 226.

Kach (Kutch): [Mem. and Notes, &c., by many authors—*see* Records, Bomb. Gov., 1855, 74, 212–14].
Kellogg: [Proc. Calif. Acad. Science, 1873, v., 82–3], 65.
[**Kew Bull.** Add., series II., 1898], 181.
Koster: [Travels in Brazil, 1816, 365–9], 168, 267, 295, 298, 303, 307.
Ktesias of Kindos: [The Assyriaka, or the first Account of India—*see* McCrindle's Megasthenes], 12.
Kurz, Dr. S.: [For. Fl. Burm., I., 129, 1877], *see* App. A.

Labat, Père Jean-Baptiste: [Nouv. Voy. aux Iles de l'Amer., 1724, I., pt. 2, 125–31 et t.], 120, 255, 259; . . . [Nouv. Rel. de l'Afrique Occid., 1728, III., 262–9, t. 261], 210, 259, 311.
Lamarck: [Encycl. Meth. Bot., 1786, II., 133–5], 82, 143, 156, 189, 201,

247, 250, 265, 247, 255, 260, 261, 271.—*See* Poiret.
Lancaster, J.: [1594—in Hakl. Voy. IV., 207, 1810], 303.
Lasteyrie, De: [Du Cotonier, 290].
Lawrence, H. S.: [Report Bomb. Agri. Dept., 1904–05, 5], 225.
Lecomte, H.: [Le Coton, Paris, 1899], 26.
Leigh, Evan: [The Science of Modern Cotton Spinning], 36.
Leo, John, or Giovan Leone Africanus, 1515 A.D.: [Pory transl. 1600], 172, 173.
Leper et Perr.: [in Samuel Brunner's Ergebnisse Senegambia Botan. Zeitung, 1840, I., pt. 2, 751], 168.
Lerius, John: [Hist. Brazil. 1557–8 apud Purchas IV., 1333], 295–326.
Ligon, R.: [Hist. Barbados, 1657], 186, 187, 270.
Lignon, A. & I.: (Contributed Cottons to Tournefort from Guadelupe: were confused by Miller and others with Ligon), 186.
Lindau: [in Engler & Prantl, Pflanzenfam. IV., 3B, 274–336], pollengrains, 350.
Linnæus: [Hort. Cliff., 1737, 350], 81, 156, 295; . . . [Fl. Zeyl., 1787, 98], 140; . . . [Hort. Upsal., I., 1748, 203–4], 156, 265; . . . [Sp. Pl., 1st ed. I., 511–2], 204; . . . [II., 693]; . . . [2nd ed. 1763, II., 975], 3, 4, 5, 81, 91, 70, 119, 140, 153, 156, 183, 204, 265, 268, 273, 295; . . . [Sp. Pl. ed. 4 by Willd. III., 805], 81, 156, 162, 301, 306, 314, 332; . . . [Syst. Nat. 1767, II., 462], 119, 143, 188, 190, 201, 202, 203, 301.
Linschoten: [Travels in East Indies, 1590, I., 55, 63, 91, 95].
Liotard: [Note on Nankin Cotton in India, 1883].
Livingstone: [The Zambesi and its Tributaries, 111], 154, 196.
Lobel: [Stirp. Hist. et Adv., 1576, 291–2, 370], 155, 159, 161.
Lubbock: [Seedlings, I., 259–60, 1892], 57.
Lugard, Lady: [Cotton-growing in Nigeria], 181.
Lugard, Capt. F. D.: [The Rise of our East African Empire, 1893, I., 408–9, 430–1], 311.
Luillier: [Nouv. Voy. aux Grandes Ind. 1726, 51], 103.
Lush, Charles: [Introduction of Pernambuco Cotton into West India—official papers—1839], 314.
Lyde, Major M. T.: [Agri. Ledger, No. 9 of 1898], 226.
Lyman: [Cotton Culture, 153], 307.

MacBryde & Beal: [in Charles W. Dabney's Cotton Plant], 40.
MacCrindle, J.: [Megasthenes, 55, 218–9], 12.
Macfadyen: [Fl. Jam., 1837, I., 72–3], 96, 101, 168, 183, 191, 250, 265, 271, 290, 291, 295, 301, 302.
Macpherson: [Hist. Europ. Comm. with Ind., 1812, 40, 136, 223, 389], 307, 313.
Maddox, C.: [Essay on Cult. of Cotton in Journ. Agri. Hort. Soc. Ind., XIII., 9–31], 149.
Maiden: [Useful Native Pl. of Australia, 1889, 131], 64.
Mallet, J. W.: [Conditions Involv. in Success. Cult., 1862], 149.
Manchester Cotton Supp. Assoc.: [Pamphlet on Cult. New Orleans Staple, 1864]; . . . [Chamber of Commerce, Monthly Record, 1903], 106.
Mandelslo, J. A.: [Voyages & Travels to E. Indies, 1638–40, Engl. transl. by Davies—many passages, 27–8, 31, 52, 62, 83, 88, &c.], 144.
Marcgraf, de Liebstad: [Hist. Rer. Nat. Bras. apud Pison., 1648, 59], 18, 295, 298, 301].
Marques, Cezar Augusto: [Dict. Maranhao, 13], 303.
Manning, Mrs.: [Ancient & Mediæval Ind. II., 356–8].
Marsden: [ed. Marco Polo, 237] opinion of Marco Polo's tree cotton, 135; . . . Hist. Sumatra, 1811, 157.
Martinet: (lysigenetic glands of the leaves), 56.
Martius—*see* Schumann.
Martyr, Peter: [Decades discov. America 1516, Hakl., vol. v., 170, 189, 192, &c.], 304.
Masham: [Hakluyt Voy. &c. IV., 195], 304.
Masters, Max T.: [in Fl. Br. Ind. I., 346–7], 73, 82, 96, 127, 143, 265; . . . [in Oliver Fl. Trop. Afri. I.], 82; . . . [Journ. Linn. Soc. XIX., 1881, 212–4], 316.
Mas'údi: (an Arab writer from whom Abú Zaid compiled—*see* Sulaimán), 13.

Masum, Mir Muhammad: [Hist. of Sind, 1600 A.D.], 14, 136.
Matthiolus: [New Kreuterb., 1563, 132, 161; also Camerarius ed. 1611, 117, 160], 155.
Mayers: (account introduction cotton into China), 13.
Megasthenes—*see* McCrindle.
Mell, Dr. P. H.: [Climatology of Cotton Pl., 1893, U.S. Dept. Agri. Bull. No. 8], 239, 310.
Mendel, Gregor: [Exper. in Pl. Hyb. transl. by W. Batson in Jour. Roy. Hort. Soc. Engl. vol. 26, 1901], 341, 350.
Merian, Maria: [Surinaamse Insect, 1679, t. 10], 255, 257, 259, 306.
Meyen: [Reise II., 323, 397, 1836], 114; . . . [Verh. der Gartnb. der Preuss. Staat., XI., 258, t. 3], 114, 118–9; . . . [Outlines Geogr. Pl. 1836, transl. by Margaret Johnston, 1846, 400–3].
Michaux, F. A.: [Travels to the Alleghany Mountains, 1802], 278.
Middleton, Prof. T. H.: [The Agri. Ledg. 1895, No. 8], 108, 112, 113, 128, 130, 131, 134, 135, 137, 148, 150, 152, 153.
Miers: [MS. Notes in B.M.], 57, 63, 167, 210, 213.
Milburn: [Or. Comm., 1813, I., 208, 279–82], 17, 148.
Miller, Philip: [Gard. Dict., 1st ed. 1731], 156, 186, 187, 188, 191, 295, 324; . . . [2nd ed., 1732; 3rd ed. 1733; 4th ed. 1741, also 1748; 5th ed. 1747; 6th ed. 1752—he corrects his description of G. hirsutum—and 1771]; . . . [7th ed. 1759, n. 4, also 8th ed. 1768], 96, 183, 188, 265.
Mockler-Ferryman: [British West Africa, 2nd ed. 1900, 63, 83, 165, 439–41], 173, 175, 176.
Mollison: [Textbook, Ind. Agri. III., 1901, 215–24], 143.
Monie, Hugh: [The Cotton Fibre, &c., 1890], 25.
Moore & Betche: [Handbook Fl. New S. Wales, 61], 64.
Morel, E. D.: [Empire-grown Cotton, 1904], 197.
Morison: [Pl. Hist. Univers. Oxon., 1699, 517, t. 17], 159, 295.
Morris & Bovell: [Sea Island Cotton in the West Indies, Bull. IV., No. 4, 1904], 285, 290, 291, 340, 341.
Morris, Sir D.: [A.B.C. of Cotton Planting, No. 31, 1904, issued by Imp. Dept. Agri. W. Ind.], 224, 239, 277; . . . [also Cantor Lectures Soc. of Arts, 1895, 896]; . . .[Address delivered before the West India Committee], 291; . . . [Seedlings of Sugar-cane], 340–1.
Mortimer, J.: [Cotton from Field to Factory, Manchester 1894], 239.
Mosenthal, H. de: [Journ. Soc. Chem. Ind., March 1904], 34.
Mueller, Sir Ferdinand Baron von: [Frag. Phyt. Austr., III., 6, 1863 et VI., 169, 251 et IX., 126, 127], 63, 65, 67.
Mueller, C.: [Walp. Ann. Bot. VII., 410–4, 1868], 66, 96, 108, 112, 265, 275, 413.
Mukherji, N. G.: [Handbook Ind. Agri., 1901, 316–21].
Murray, J. A.: [Prod. Stirp. Gött., 1770, 170], 156; . . . [Comm. Soc. Reg. Gött., 1776, VII., 20, 22, t. 1], 183.

Nearchus: (Description of the 'linen' garments of India), 11, 12.
Niess, B. de: [Baumwollen, Spinnerei, &c., Weimar, 1885].
[**News and Courier**, in West Ind. Bull., IV., 1904], 288.
Nuttall: [in Seem. Fl. Vit. 1865, 22], 69.

Olearius, Adam: [Voy. and Trav., 1638, Engl. transl. by Davies, many passages on Armenia, Persia, and India, 227, 271, 276, 303, 305, &c.].
Oliver: [Fl. Trop. Af., 1868, I., 210–12], 96, 143, 169, 174, 183, 214, 256; . . . [Hook. Ic. Pl., XIX., t. 1336], 72.
O'Neill, Charles: [Calico Printing, Bleaching and Dyeing], 39.
Orton, W. A.: 280 (paper read before the Conference on Hybridisation of 1902), 330.
Oviedo: [Hist. Nat. Ind. I., 1535, Pl. del Algodon, lib. 10; also summary by Eden], 304.

Parkinson: [Paradisus, 1629, 2nd ed. 1640, pp. 1,552–4], 161.
Parlatore: [Spec. dei Cot., 1866], 63, 69, 82, 96, 114, 156, 183, 201, 210,

214, 248, 256, 265, 275, 295; . . . [Fl. Italiana, 1872, v., 20], 156.
Pausanias: [Description of Greece, v., ch. 5; vi., ch. 26].
Pena et Lobel: [Stirp. Adv. Nov. 1570, 291], 159.
Periplus: [Erythræan Sea, ed. McCrindle, 18, 112–5, (63 A.D.)], 12, 13.
Petherick: [Travels in Central Africa, 1869, i., 236], 311.
[**Philosophical Magazine**, Nov. 1834], 25.
Piso: [De Med. Bras., ii., 1615], 255; . . . [Nat. Hist. utriusque Ind., 1658, 186—he republished the early scientific works regarding America such as Bontius, Marcgraf, Ximenes], 295.
[**Planter**, Aug. 29, 1896], 128.
Pliny: [79 A.D. Bk. xii., ch. 10, 11; xix., ch. 1, Holland's Engl. transl.], 11, 14, 59, 85, 86.
Plukenet, Leonard: [Alm. Bot., 1696, 172–3 and Phyt. 1691–1700 tt. 188, 299], 81, 84, 93, 114, 119, 145, 186, 188–9, 204, 265, 268–9, 295, 300; . . . [Amæth., 1705, 107], 95.
Poiret: [Dict. des Scien. Nat., xi., 34–60, 1818], 82, 114, 156, 157, 173, 175, 183, 201, 203, 226, 250, 253, 254, 255, 264, 265; . . . [Lamk. Encycl. Supp. ii., 368–70, 1811], 114, 213, 250, 295.
Pollux, Julius: [Onomasticon, cf. Ritter, p. 26], 14.
Polo, Marco: [Travels 1290, A.D., Sir H. Yule's ed., i., 57, 126, 169, 173, 175; ii., 78, 328, 330, &c.], 135.
Pomet: [Hist. Drug., 1694, Engl. transl. 1712, i., 153–4], 156, 160.
Porta: [Villa, 1592], 159.
Prain, Col. D.: [Sketch of the Life of Francis Hamilton (once Buchanan) in Ann. Royal Bot. Gard. Calc.], 104.
Prefontaine, M. de: [Maison rustique, 1763], 305.
Prescott: [Conquest of Mexico].
Purchas: [Pilgrims, 1625 A.D., i., 11, 63, 415; ii., 913, 1,279, 1,415, 1,547, 1,687; iv., 1,189, 1,248, 1,264, 1,265, 1,275, 1,351, 1,784], 100, 304.
Pyrard, François: [Voy., 1601, transl. by Gray & Bell, vol. i., 146, 222, 228, 241, 328; ii., 364].
Queensland: [Agri. Jour. ix., 115, 1901], 275, 294.
Quer, Don J.: [Contin. de la Fl. Espanola, 1784, vi., 502–5], 160.
Raibaud: [Le Coton, Paris, 1863].
Ramusio: [Navig. in 1454 of Alvise da ca Da Mosto, (ed. 1837) i., 189], 172.
Rashiduddin: [Jamiu-t Tawarikh, 1310 A.D.], 14, 136.
Rauwolff: [Hodoep. 1583, i., 5, 65], 159.
Rauwolff, L.: [Fl. Orient., 1755, 84].
Rawlinson: [Hist. Ancient Egypt, I., 1881, 63], 157.
Rawson, Gardner and Laycock, Dict. of Dyes, Mordants, &c. (1901)—'Cotton,' origin of, mode of growth, physical structure, chemical composition, reactions, mercerisation, cellulose, oxycellulose, action of reducing agents, action of mordants, action of colouring matters, and impurities of, &c., pp. 117–26.
Reinaud—*see* Sulaiman.
Renaudot, Abbé—*see* Sulaiman.
Reynier: [Economie des Arab. et des Juifs, 363].
Rheede: [Hort. Malabaricus, 1686, i., 55 t. 31], 14, 95, 98, 99, 140.
Richard: [Tent. Fl. Abyss., 1847, i., 63–4], 156, 158, 173, 255.
Richter: [Codex Linn.].
Ritter, C.: [Geog. Dist. of Cotton, 1852, 25].
Rivers: [Hist. Sketch South Carolina], 22; . . . E.L., Wilt-resistant plants, 284.
Rivett-Carnac, H.: [Repts. Cotton Dept. of Ind., 1867–9], 149; (seeds supplied to) 111, 336.
Robinson & Green: [Contr. Gray Herb. No. 9, 145], 68.
Robinson: [Fl. Galap. Is., 1902 in Proc. Am. Ac. Arts, xxxviii., Contr. from Gray Herb.], 66, 68.
Rochefort: [Hist. Nat. et Mar. des Isles Antilles, 1658, 81–2], 259.
Roe, Sir Thomas: [Embassy of, to Court Great Mogul (Foster's ed.), 1615–19], 14, 136.
Rohr: [Observ. sur la Cult. du Cot. (Germ. ed. 1790, Fr. ed. 1807)], 7, 96, 100, 103, 109, 120, 144, 168–9, 183, 250, 254, 255, 262–3, 267, 295, 305, 333.

Rolfe: [Journ. Linn. Soc. xxi., 308], 72.

Roxburgh: [Hort. Beng., pub. 1814, 51], 228, 295; . . . [Fl. Ind., 1832, iii. 183–8], 82, 96, 104, 114, 131, 142, 145, 183, 201, 213, 228, 229, 250, 261, 295, 314; . . . [Pl. of Coast of Coromandel, iii., 1819, 66, t. 269], 96, 103.

Royle: [Cult. & Comm. of Cotton in Ind., 1851], 25, 74, 82, 96, 104, 136, 149, 183, 250, 256, 265, 295; . . . [Illus. Him. Bot., 1839, 86, 99, t. 23 f. 2], 82, 96.

Ruellius: [De Nat. Stirp., 1537, Bk. ii., ch. 150], 155, 159.

Rumphius: [Herb. Amb., iv., 33–37, t. 12 (1750)], 114, 128, 129, 140, 255.

Sachs: [Textbook of Botany, Vine's transl., 2nd ed., 1882, 555], 349.

Sadebeck: [Kulturgew. der deut. Kolonien., 1899, 304–10], 26, 255, 266, 293.

Safford, W. E.: [Useful Plants of Guam., pub. in Contrib. U.S. Nat. Herb., ix., 67], 58, 83.

Saint-Hilaire, A. de: [Fl. Bras. Merid., i., 354, 1825], 17, 255, 308, 310.

Salmasius: [Plinianæ Exercit., 1689, 209–11].

Schacht, Hermann: [Pringheim's Jahrbucher für wissensch. Bot., ii., 1860, p. 109–68, t. xiv.–xviii.], 348.

Schlosser & Vukotuiovic: [Fl. Croaticæ, 1857, 180], 156.

Schouw: [Naturschild (1840), 149–52].

Schumacher et Thonning: [Beskr. Guin. Pl., 1827, 309–10], 168.

Schumann, C.: [Martius, Fl. of Brazil, 1892, xii., pt. iii., 582–6], 96, 101, 174, 183, 206, 256, 265, 266, 267, 296, 299, 310.

Schweinfurth & Ascherson: [Aufzählung, 265].

Schweinfurth: [Le Piante utili dell' Eritrea, Soc.-Afr. d'Italia, x., 1891] —*see* App. A.

Seelhorst, W.: [Transl. by Teysmannia in Bull. Straits & Fed. Mal. States, iii., 195–232], 294.

Seemann: [Fl. Vit., 1865, 21-2], 4, 69, 71, 295; . . . [Jour. of Botany, iv., 1866, 268–70], 4, 248.

Semler: [Trop. Agric., iii., 1903, 492], 26.

Sen, A. C.: [Rept. on Agri. and Agri. Stat., Dacca, 1889], 107.

Serapion: [De Simpl., 850, A.D. 1479, sec. 62], 13, 85, 135.

Shaw, T.: [Trav. & Obser. relating to Barbary and the Levant, 1757], 160.

Shepperson: [Cotton Facts, New York, 1893], 239.

Shevade, S. V.: (in Gammie's Indian Cottons), 59.

Shortt: [Prize Essay on Cotton Cult. Ind., 1862], 149.

Sicard, Dr. Adrien: [Guide Pratique de la Cult. de Coton, Paris, 1866].

Slater, J. S.: (Special Study of Pollen Grains for this work), 343–5.

Sloane, Sir Hans: [Cat. of the Pl. of the Island of Jamaica, 1696, 156–60, gives extensive list of early publications on cotton], 295, 304, 326; . . . [Nat. Hist. of Jamaica, ii., 1725, 67], 216, 304.

Small: [Fl. South-eastern U.S.A., 1903, 778], 183, 184, 201, 266.

Solander: [in Seem. Fl. Vit., 1865, 22], 248.

Sonnerat: [Hist. Voy., 1782, x., 460], 83, 93, 261.

Sonnini: [Travels in Greece and Turkey, Engl. ed. 1801, i., 54–5, 57, 72; ii., 132].

Souza—*see* De Souza.

Spach: [Hist. Nat. Veg. iii., 388–95, 1834], 156.

Spielmann, Prof.: of Strasburg, 189.

Spix & Martius: [Travels in Brazil, i., 1817–1820, 189, 191; ii., 15], 239, 277.

Splitgerber: [Bot. Surin. MSS. publ. by Guil. H. de Vriese in Nederl. Kruidk. Arch., 1848, i., 334], 96.

Sprengel, C.: [Hist. rei Herb., 1808, i., 15, 146, 265, 328, 383; ii., 92, 156, 500].

Spruce: [Cult. of Cotton N. Peru, 1864], 33, 183, 210, 214–5, 217, 218, 256, 265, 280, 295, 308, 320.

Spry: (Jour. Agr. Hort. Soc. Ind.), 229.

Stephens: [Rambles in Yucatan], 207.

Stewart, Mr. Ch.: (paper read before Br. Assoc., 1896), 51.

Stocks, Dr.: (MS. name in Kew Herb., given by), 74.

Strabo: [early Greek Historian, *see* McCrindle's transl. of Megasthenes], 12.

Strasburger: [Lehrbuch der Bot., 1894, 368], 349.
Sturt.: [Exp. Cent. Austr., II., App., 68], 63.
Subbiah, P. V.: [Bull. No. 15, 1901, of Dept. Agri. U. P. Ind.], 96.
Sulaiman: [Jour. of Travels, 851 A.D.; annotated by Abu Zaidu-l-Hasan 916 A.D.; transl. 1718 by Renaudot and again in 1845 by Reinaud], 13.
Swartz: [Kongl. Vetensk. Akad. Handl., XI. 20–5, 1790], 183, 190, 265, 295.
Symes: [Emb. to Ava, 1795, II. 83], 129.

Tabernæmontanus: [Icones, 1590]: gives plate of G. herbaceum, Linn., after that of Matthiolus, also of Fuchsius, 159.
Talbot: [Trees, Shrubs, &c. Bomb. Pres., 2nd ed. 1902, 38], 73.
Targioni-Tozzetti: [Jour. Hort. Soc. London (transl. and annot. by G. Bentham), IX., 149, 1855], 158.
Tavernier: [Travels, &c., 1670–89, (Ball's transl., 1889), II., 4–8, 27–31].
Taylor, Dr. James: [Description and Hist. Acc. of the Cotton Manuf. of Dacca, pub. by John Mortimer, 1851], 105, 106.
Tenore, Prof.: [Rev. of paper in Roy. Asiatic Soc., 1837, 98], 156.
Terry, Rev. E.: [Voy. to East India, 1615, ed. 1655, p. 108, also ed. Havers, p. 368], 14, 136.
Teysmann: [Manual of Cotton-growing in the Netherlands], 294; *see also* under Seelhorst.
Theophrastus: [350 B.C., Hist. Pl., Bk. IV., c. 5, 9, ed. Scaliger, 1644, 347, 422], 11.
Thiselton-Dyer, Sir W.: [Kew Bull. Add. Ser. 1898], 199, 315.
Thomas, F.W.: (passages form Sanskrit authors), 9.
Thomson: [Herb. Ind. Or. Hook. f.], 125.
Thomson, James, of Clitheroe: [Mummy Cloth of Egypt with plates by Bauer in Classical Museum, vol. VI., London, 1849, pp. 154-6], 25
Thonin, D.: (Note in Cav. Diss.), 261.
Todaro, Prof. A.: [Osser. su Tal. Sp. di Cot.], 63, 96, 108, 112, 275; . . . [Relaz. Cult. dei Cot., 1877], 4, 64, 67, 69, 71, 74, 82, 91, 95, 112, 114, 139, 143, 156, 169, 183, 201, 206, 210, 226, 248, 256, 250, 265, 275, 281, 295; . . . [Hort. Bot. Pan., 1864, 32; also 1876–78, 64, t. 14], 210, 211.
Torrey & Gray: [Fl. N. Am., 1838–40, I., 230], 156.
Tournefort: [Inst. rei Herb. I., 101, 1719; also Compl. Herb., I., 72–5], 186–7.
Tracey, S. M.: [in Dabney's The Cotton Plant, 1896], 332.
Trelease, Prof. Wm.: [Nectar, Its Nature, Occurrence, and Uses, pub. in J. H. Comstock's Report on Cotton Insects], 58.
Triana et Planchon: [Fl. Novo-Granatensis, 1862, 170–1], 265.
Trigault: [De Christ. Exped. apud Sinas, 1615 (quoted by Bretschneider), Hist. European Bot. Disc. in China, 11], 118.
[**Tropenpflanz.** vol. II., 123; III., (East Africa) 536–45; VI. (Egypt), 201, 355; V. (Asia), 41, 530–6; (India), 202, 250, 253, 257, &c.; VI. (Cotton Manures), 261; VII. (Br. E. Africa), 606; VIII., 512, 392, &c.].
True, A. C.: [The Cotton Plant, in Bull. U. S. Dept. Agri. 1896], 239.
Truth: The Naked,—pamphlet on Cotton Trade, 19.
Tucker, H. St. George: [Note on Indian Cotton], 314; . . . [Reports on Cotton, &c. in E. India Company's Letters, pub. 1836, 160], 104.
Turpin: [Planches to Dict. des Scienc. Nat. IV., t. 42], 201.
Tussac: [Fl. Antl. 1818, II., 65–77, t. 17], 183, 114, 201, 255, 267, 295.

Valle, Della: [Travels in India, 1623], 14.
Varley: (Microscopic studies of Cotton), 25.
Varthema (Vertomannus): [Travels in East, 1503, in Hakl. Voy. IV., 5, 38, 107, 114, 153, 198, 212, 222, 574], 144, 159.
Vaupell: [Cot. of Gujarat], 295.
Vaz, Lopez: (visited Pernambuco in 1586), 303.

Vellozo: (Arrab.) [Fl. Flum. VII., 1827, t. 49], 295.
Vesling: [Ed. Prosper Alpinus, 1640] —*see* Alpinus, 161.
Vesque, J.: [Traité de Bot. Agri. et Ind., 1885, 474–7], 183, 248.
Vétillart: [Fibres Végétales, 1876, 130–43], 26.
Voisson, M. Louis: [L'Indust. Cotonnière dans l'Inde, 1903].
Volkamer: [Fl. Norib. 1700, 195], 156; . . . [Nurnberg. Hesp. II., 235, 1714], 114.

Wallace: [Island Life, 1892, 287–9], 67.
Walpers: [Ann. Bot. IV.]—*see under* Mueller, C.
Walsh, Patrick: (Origin of Sea Island Cotton), 20, 276.
Walton: [Hist. Cotton in Belgaum, 1880], 149.
Warburg & Woltmann: [in Tropen. 1904, Cotton Cult. & Prod. in the World, 323–52; 1906, ditto, 1–113].
Ward, H. Marshall: [Trees, III., 93, 1905], 350.
Watkins, J. L.: [Production of Cotton for 100 Years, 1895, in U.S. Dept. Agri. Bull. No. 9], 239.
Watson, Dr. Forbes: [studies of cotton and Indian cotton textiles), 25.
Watt, Sir Geo.: [Cotton Improvement, a paper read before the West Ind. Comm., Circ. vol. XIX., 1904], 150; . . . [Dict. Econ. Prod. Ind., IV., 1890], 82, 108, 128, 131, 134, 146, 266; . . . [Report Manchester Guardian, June 11, 1903], 106; . . . [Tree Cottons, controversy regarding, 315]; , . . Species described by, in this work, pp. 68, 91, 95, 108, 112, 124, 126, 128, 131, 134, 143, 201, 275.
Watts, Hon. Dr. R. F.: (Reports on Leeward Island Cottons], 239.
Webber, H. J.: [Bull. of Bureau of Pl. Indus.], 282, 283, 330.
Weisner, Julius: [Indische Faserpflanzen, also Die Rohstoffe des Pflanzen-Reiches, II., 221–64, 1903], 26, 293, 296.
Welwitsch, Dr. F.: [Cat. Af. Pl. 1896, pt. I., 78–9, by Hiern], 169, 210, 296.
Wheeler, J. T.: [Handbook, Cotton Cult. Madras], 149.
Wight & Arnott: [Prod. Fl. Pen. Ind. Or. 1834, I., 54–5].
Wight, R.: [Agri. Hort. Soc. of Ind. VI., 189–196; VII. 194–215], 229; . . . [American Cotton Agriculture as practised at Govern. Cotton Farms of Coimbatore, 1843], 261; . . . [Icon. Pl. Ind. Or., I., 1840, nn. 9/198, 10/198, & 11/198], 82, 143; . . . [Ill. Ind. Bot. I., 1840, nn. 27, 28a, b, & c], 151, 183, 250, 261, 265, 294, 295; [. . . and Arnott—*see* above].
Wilson, Samuel: (description of Carolina, 1682), 160.
Wilson—*see* Purchas.
Wilson, E: (Microscopic studies of cotton), 25.
Wildeman: [Fasc. IV., Mission E. Laurent to Congo, 1907, 389–95], 321.
Willdenow: [in Linn., Sp. Pl. 4th ed. 1800, III., 803–6], 93, 114, 183, 213, 261, 265, 295.
Winterbottom, Dr. F.: Acc. of the Natives of Sierra Leone, I., 95, 1803], 173.

Ximenes, F.: [Nat. Hist. Mexico, apud Pisonem, 1615].

Yates, I.: [Textrinum Antiquorum, 1843, 334–54], 86; . . . [Text. Anti. App., 467–72], 15, 157.
Yule, Sir H.: [*see* Marco Polo].

Zanoni, G.: [Istoria, Bot., 1675, 40–4, t. 14], 18, 295, 300.
Zanoni, Jacob: [Hist. Stirp., 1742, 235, t. 182].
Zenker & Schenk: [Waarwnkunde, II., 53–67, 1832], 156.

APPENDIX C

List of the Names of Species and Varieties with their Synonyms

The figures denote the pages in this Work where the plants are dealt with. The names rendered in capitals are the species as accepted by me; those in ordinary type are the species reduced to varieties, and the italics denote the synonyms of the species and varieties.

Alcea malabarensis (*cuda pariti*), *Rheede* = G. arboreum, *Linn.*, var. neglecta, *Watt*, 95.

Ameniiou (*Bombasin*) of *Lerius* = G. brasiliense, *Macf.*, 295, 303.

Aminiiu of Marcgraf = G. brasiliense, *Macf.*, 295.

Bambagia arborea di Pernambuco, *Zanoni* = G. brasiliense, *Macf.*, 295.

Capas of *Rumphius* = G. Nanking, *Meyen*, var. Nadam, *Watt*, 128, rather than typical G. Nanking, *Meyen*, 114.

Cienfuegosia Gossipioides, *Hochr.* = G. Sturtii, *F. v. M.*, 64.

Cienfuegosia Robinsoni, *Hochr.* = G. Robinsoni, *F. v. M.*, 67.

G. acuminatum: Roxb., 274, 295, 301; *Welw.*, 296; *Wight* (Illus. t. 27) 295 = G. brasiliense, *Macf.*

G. aegyptiacum, *Jameson* (MS. in Edin. Herb.) = G. hirsutum, *Linn.*, 185.

G. albiflorum, *Tod.* = G. arboreum, *Linn.*, var. rosea, *Watt*, 112.

G. album, *Ham.* (Linn. Soc. Trans., xiii., 1822, 494) (with seed and wool both white) = fuzzy-seeded cottons such as G. herbaceum, Linn.; G. obtusifolium, Roxb.; &c., 84, 248.

G. anomalum, *Tod.* = Cienfuegosia pentaphylla, K. Schum., 63.

G. arborescens of *Burlamaqui* = G. brasiliense, *Macf.*, 309.

GOSSYPIUM ARBOREUM: *Rumphius* (in part); *Alpinus*; *Plukenet*; *Boerhaave*; *Linn.*, *Hort. Cliff.* (in part); *Burm.* (in part); *Lamk.*; *Cav.*; *Poir.* (in part); *DC.* (in part); *Roxb.*; *Wall.* (Cat. 1881a. in part); *Parl.* (in part); *Royle* (in part); *Wight* (in part); *M. Mast.* (in part); *Tod.*; *Aliotta* (in part); *Gammie* (in part); 81–2 = G. arboreum, *Linn.*

GOSSYPIUM ARBOREUM, *Linn.*, var. ASSAMICA, *Watt.* = (*Kil* cotton of *Darrah* & *Middleton*), 108.

G. arboreum; *Engler & Prantl*; *Miller*; *Oliver* (in part); *Parl.* (in part); = G. arboreum, *Linn.*, var. neglecta, *Watt*, 96.

G. arboreum, *Forsk.* = G. herbaceum, *Linn.*, 156.

G. arboreum, *Gammie* (in part) = G. obtusifolium, *Roxb.*, 5, 332.

GOSSYPIUM ARBOREUM, *Linn.*, var. NEGLECTA, *Watt*, 95.

GOSSYPIUM ARBOREUM, *Linn.*, var. ROSEA, *Watt*, 112.

GOSSYPIUM ARBOREUM, *Linn.*, var. SANGUINEA, *Watt.*, 91.

G. arboreum, *Vellozo* = G. brasiliense, Macf. 295.

G. australiense, *Tod.* = G. Sturtii, *F. v. M.*, 63.

GOSSYPIUM BARBADENSE: *Pluk.*; *Linn.*, *Hort. Ups.*; *Miller*; *Lamk.*; *Cav.*; *Swartz.*; *Willd.*; *Poir.*; *DC.* (in part); *Descourt.*; *Macf.*; *Wight* (Illus. t.

28b); *Royle* (in part); *Triana & Planch.*; *Griseb.* (in part); *Spruce*; *Parl.* (in part); *Tod.*: *C. Muell.*; *Hemsley*; *M. Mast.*; *Schum.*; *Heuzé*; *Evans* (in part); *Sadebeck*; *Engler & Prantl* (in part); *Small*; *Aliotta* (in part); = G. barbadense, *Linn.*, 265–6.

G. barbadense, *var. acuminata*, *Aliotta* = G. barbadense, *Linn.*, 274.

G. barbadense: '*Bot. Reg.*'; *Hook. & Arn.*; *Oliver* (in part); *Parl.* (in part); = G. vitifolium, *Lamk.*, 255–6.

G. barbadense, *var. integra*, *Griseb.* = G. peruvianum, *Cav.*, 216.

G. barbadense: *Hook. & Arn.*; *Hook. & Benth.*; *Oliver* (in part); = G. punctatum, *Sch. et Thon.*, 168–9.

GOSSYPIUM BARBADENSE, *Linn.*, var. MARITIMA, *Watt*, 275.

G. barbadense, *Oliver* (in part) = G. peruvianum, *Cav.*, 214.

G. barbadense, *Parl.* = G. barbadense, *Linn.*, var. maritima, *Watt*, 275.

G. barbadense, *Robinson* = G. Darwinii, *Watt*, 68.

G. barbadense: *Roxb.*; *Wight* (Ill. t. 28a); = G. purpurascens, *Poir.*, 250.

G. barbadense, *Wight* (Ill. t. 28c) = G. hirsutum, *Linn.*, 183.

GOSSYPIUM BRASILIENSE: *Tod.* (in part) = G. brasiliense, *Macf.*, 293.

G. brasilianum, *Sloane Herb.* = G. peruvianum, *Cav.*, 216; . . . in (Pl. Ins. Jam., in part) = G. brasiliense, *Macf.*, 295, 302.

G. caespitosum, *Tod.* = G. punctatum, *Sch. et Thon.*, 169.

G. caule decumbente, *Linn.* (*Hort. Cliff.*) = G. brasiliense, *Macf.*, 295.

G. cernuum, *Gammie* (*non Tod.*) = G. arboreum, *Linn.*, var. rosea, *Watt*, 112.

G. cernuum: *Tod.*; *C. Muell.*; = G. arboreum, *Linn.*, var. assamica, *Watt*, 108–9.

G. congestum, *Miers* (*MS. in Br. Mus.*) = G. microcarpum, *Tod.*, 210.

G. conglomeratum, *Wiesner* = G. brasiliense, *Macf.*, 296.

G. croceum, *Ham.* = G. hirsutum, *Linn.*, var. religiosa, *Watt*, 42, 201, 203, 204.

GOSSYPIUM DARWINII, *Watt.*, 68.

GOSSYPIUM DAVIDSONII: *Brewer and Watson* = G. Davidsonii, *Kellogg*, 65.

GOSSYPIUM DRYNARIOIDES: *Hilleb.*; *Tod.*; = G. drynarioides, *Seem.*, 71.

G. Figarei, *Tod.* = G. ? purpurascens, *Poir.*, 274.

G. flavescens, *MS. Herb. Calc.* = G. vitifolium × mexicanum hybrid, 258.

G. frutescens annuum folio trilobato barbadense, *Pluk.* = G. barbadense, *Linn.*, 265.

G. frutescens annuum folio Vitis ampliori quinquifido, &c., Pernambuco, *Pluk.*; *Miller*; = G. brasiliense, *Macf.*, 295.

G. frutescens: *C. Bauhin*; *Jonston*; = G. herbaceum, *Linn.*, 155, 159.

G. frutescens, *Lasteyr* = according to *Tod.*, G. peruvianum, *Cav.*; to *Evans*, G. barbadense, *Linn.*; but according to *Aliotta*, ? G. brasiliense, *Macf.*, 273–4.

G. frutescens pentaphyllos, *Pluk.* = G. Nanking, *Meyen*, 114.

GOSSYPIUM FRUTICULOSUM, *Tod.*, 206.

G. fuscum, *Roxb. MS. name* = G. hirsutum, *Linn.*, var. religiosa, *Watt*, 201, 273.

G. glabrum, *Lamk.* = G. purpurascens, *Poir.*, 247, 250, 261, 273.

GOSSYPIUM HARKNESSII, *Brandg.*, 173.

GOSSYPIUM HERBACEUM: *Ruellius*; *Fuchsius*; *Matth.*; *Lobel*; *J. Bauhin*; *Jonston*; *Pomet*; *Volkamer* (in part); *Boerh.*; *Miller*; *Linn.*, *Hort. Cliff.* (in part); *Linn.*, *Hort. Ups.* (in part); *Murray*; *Lamk.*; *Cav.* (in part); *Willd.* (in part); *Poir.*; *DC.* (in part); *Zenker and Schenk*; *Spach*; *Tenore*; *Torry and Gray*; *Darlington*; *DC.* (*Bot. Geogr.*); *Parl.* (in part): *Schlosser and Vukotin.*; *Tod.*; *Heuzé*; *Engler and Prantl*; *Aliotta* (in part); = G. herbaceum, *Linn.*, *Sp. Pl.*, 155–6.

G. herbaceum: *Aliotta* (in part); *Tod.* (in part); = G. Stocksii, *M. Mast.*, 73–4.

G. herbaceum : Aliotta (in part) ; *Gammie ;* = G. obtusifolium, *Roxb.*, 5, 139, 332.

G. herbaceum : Aliotta (in part) ; *Oliver* (in part) ; *Wight* (Ic. t. 9) ; = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, 143.

G. herbaceum, var. lana rufa, Aliotta, = G. Nanking, *Meyen*, 114.

G. herbaceum, Baxendale (the *kala-kala* of Java) = G. Nanking, *Meyen*, 294.

G. herbaceum : Burm. ; Duthie & Fuller ; M. Mast. (in part) ; *Roxb. ;* = G. arboreum, *Linn.*, var. neglecta, *Watt*, 96.

G. herbaceum, var. hirsuta, Engler & Prantl = G. hirsutum, *Linn.*, 183.

G. herbaceum, var. Jethi, Gammie = G. Nanking, *Meyen*, var. Bani, *Watt*, 131.

G. herbaceum, Henderson & Hume = G. Nanking, *Meyen*, var. himalayana, *Watt*, 114, 125.

G. herbaceum : Oliver (in part) ; *Small ;* = G. hirsutum, *Linn.*, 183.

G. herbaceum, Parl. (in part) = G. Nanking, *Meyen*, 114.

G. herbaceum maderaspatense, &c., Pluk. = G. arboreum, *Linn.*, var. neglecta, *Watt*, 83, 95.

G. herbaceum, var. Berar cotton, Roxb. = G. Nanking, *Meyen*, var. Bani, *Watt*, 131.

G. herbaceum, var. China cotton, Roxb. = G. Nanking, *Meyen*, 114.

G. herbaceum, var. obtusifolia, Watt (*Dict. Econ. Prod.*) = G. obtusifolium, *Roxb.*, 142.

G. herba flore campanulato, Morison = G. brasiliense, *Macf.*, 295.

GOSSYPIUM HIRSUTUM : *Miller ; Swartz* (in part) ; *Edwards ; Willd.* (in part) ; *Poir.* (in part) ; *Tussac ; Roxb. ; Macf. ; Royle* (in part) ; *Spruce* (in part) ; *Parl. ; Tod. ; Vesque* (in part) ; *Schumann ; Heuzé ; Gammie ; Aliotta ;* = G. hirsutum, *Linn.* (*Sp. Pl.*), 183.

G. hirsutum of authors = G. herbaceum, *Linn.*, 165.

G. hirsutum, Cav. = G. Nanking, *Meyen*, 114.

G. hirsutum, DC. = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, 143.

G. hirsutum, var. Hardyanum, Tod. = G. hirsutum, *Linn.*, 274.

G. hirsutum, Hill = G. arboreum, *Linn.*, var. neglecta, *Watt*, 96.

G. hirsutum, Lamk. (*non Linn. Sp. Pl.*) (in part) ; *DC.* (in part) ; = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, 143.

G. hirsutum, Linn. (*Herb. et Syst. Nat. sed non Sp. Pl.*) = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, 143.

G. hirsutum, var. δ lana rufa, Parl. ; and lana rufa, Aliotta = G. hirsutum, *Linn.*, var. religiosa, *Watt*, 201.

G. hirsutum, var. β Parl. = G. lanceolatum, *Tod.*, 210.

G. hirsutum, var. lanceolatum, Aliotta = G. lanceolatum, *Tod.*, 210.

GOSSYPIUM HIRSUTUM, Linn., var. RELIGIOSA, *Watt*, 201.

G. imbricatum, Vaupell = G. brasiliense, *Macf.*, 295.

G. indicum : Lamk. ; Cav. ; Willd. ; Poir. ; DC. ; Tod. ; = G. Nanking, *Meyen*, 92, 114, 118, 120, 145, 146.

G. indicum, Gammie = G. Nanking, *Meyen*, var. Nadam, *Watt*, 128.

G. indicum, Royle = G. arboreum, *Linn*, var. neglecta, *Watt*, 96.

G. intermedium, Tod. = G. arboreum, *Linn.*, var. neglecta, *Watt*, 96, 274.

G. JAMAICENSE : MACF. ; TOD. ; = G. punctatum, *Sch. et Thon.*, var. jamaica, *Watt*, 168–9, 170, 191.

G. javanicum, Ham. quoting ? Rumphius Herb. Amb. = G. Nanking, *Meyen*, 93.

G. javanicum : Bl. ; Dcne. ; Tod. ; = possibly G. Nanking, *Meyen*—though by the early authors, *e.g.* Parkinson, *G. javanense* = Eriodendron anfractuosum—273.

GOSSYPIUM KIRKII, *M. Mast.*, 316.

GOSSYPIUM KLOTZSCHIANUM : *Walp. ; Robinson ;* = G. Klotzschianum, *Andss.*, 66.

G. Klotzschianum, Robinson & Green = G. Darwinii, *Watt*, 68.

G. lanceoforme, Miers = Thurberia thespesioides, *A. Gray*, 63.

GOSSYPIUM LANCEOLATUM, *Tod.*, 210.

G. lapideum, Tussac = G. brasiliense, *Macf.*, 295.

G. latifolium: Murray; Willd.; DC.; = G. hirsutum, *Linn.*, 183, 203.

G. latifolium, Rumphius = G. vitifolium, *Lamk.*, 255.

G. macedonicum, Spielmann = G. hirsutum, *Linn.*, 189.

G. maritimum, Hiern (in part) = G. punctatum, *Sch. et Thon.*, 169.

G. MARITIMUM: TOD.; C. MUELL.; ALIOTTA; = G. barbadense, *Linn.*, var. maritima, *Watt*, 275.

G. maritimum, var. degenerata, Tod. = G. ? peruvianum, *Cav.*, 274.

G. maritimum, var. Jumeliana, Tod. = G. barbadense, var. ?, 274, but is certainly not Jumel's cotton which = G. brasiliense, *Macf.*, 219–20, 312–3.

G. maritimum var. polycarpum, Morong (MS.) = G. peruvianum, *Cav.*, 216.

G. maritimum var. polycarpum, Tod. = G. barbadense, *Linn.*, var. maritima, *Watt*, 232, 275, 281.

G. mauritianum Rott. (MS. Herb.) = G. Nanking, *Meyen*, var. himalayana, *Watt*, 125.

OSSYPIUM MEXICANUM, *Tod.*, 226–44.

G. ? micranthum: Cav.; Willd.; Poir.; DC. = G. Nanking, *Meyen*, 20, 114.

GOSSYPIUM MICROCARPUM, *Tod.*, 210.

GOSSYPIUM MUSTELINUM, *Miers MS.*, 167.

GOSSYPIUM NANKING, *Tod.; Volkamer* (die Baumwollen) = G. Nanking, *Meyen*, 114.

GOSSYPIUM NANKING, *Meyen*, var. BANI, *Watt*, 131.

G. Nanking, var. grandiflora, Tod. = G. Nanking, *Meyen*, 121.

GOSSYPIUM NANKING, *Meyen*, var. HIMALAYANA, *Watt*, 124.

GOSSYPIUM NANKING, *Meyen*, var. NADAM, *Watt*, 128.

GOSSYPIUM NANKING, *Meyen*, var. ROJI, *Watt*, 134.

GOSSYPIUM NANKING, *Meyen*, var. RUBICUNDA, *Watt*, 126.

GOSSYPIUM NANKING, *Meyen*, var. SOUDANENSIS, *Watt*, 138.

G. NEGLECTUM: *Tod.; Subbiah; Gammie; Aliotta* = G. arboreum, *Linn.*, var. neglecta, *Watt*, 91, 95–6, 155.

G. nigrum, Ham. (Trans. Linn. Soc., XIII., 1822, 494), = naked-seeded cottons *e.g.* G. purpurascens, *Poir.*; G. barbadense, *Linn.*, &c., 84, 93, 248, 252, 273, 298.

G. nigrum, var. punctatum, Hook. & Webb = G. punctatum, *Sch. et Thon.*, 168–9, 271.

G. oligosperum, Macf. = G. arboreum, *Linn.*, var. neglecta, *Watt*, 96.

GOSSYPIUM OBTUSIFOLIUM, *Tod.; Burkill* (in part) = G. obtusifolium, *Roxb.*, 139, 141, 143.

GOSSYPIUM OBTUSIFOLIUM, *Roxb.*, var. AFRICANA, *Watt*, 153.

GOSSYPIUM OBTUSIFOLIUM, *Roxb.*, var. Wightiana, *Watt*, 143–55.

G. obtusifolium, Stocks = G. Stocksii, *M. Mast.*, 74.

GOSSYPIUM PALMERII, *Watt*, 204.

G. parvifolium, Nutt. MS. = G. tomentosum, *Nutt.*, var. parvifolia, *Watt*, 71.

GOSSYPIUM PERUVIANUM, *Edwards; Willd.; Poir.; Engler* (in part) = G. peruvianum, *Cav.*, 213–4, 274, 296.

G. peruvianum: Engler (in part); *Royle; Seem.* = G. brasiliense, *Macf.*, 295–6.

G. peruvianum, Welw. = G. microcarpum, *Tod.*, 210.

G. præstantissimum, Linn. = G. Nanking, *Meyen*, var. rubicunda, *Watt*, 91, 127; (Cf. with Xylon Americanum).

G. PROSTRATUM, SCH. ET THON. = G. punctatum, *Sch. et Thon.*, var. prostrata, *Watt*, 174.

G. ? pubescens, Schumann = G. Schottii, *Watt*, 206–7.

G. pubescens, Splitg. Msc. = G. arboreum, *Linn.*, var. neglecta, *Watt*, 96, 101.

GOSSYPIUM PUNCTATUM: *Guillemin; Perr. et Rich.: Leper et Perr.; Tod.; Welw.; Henry*; = G. punctatum, *Sch. et Thon.*, 168–9, 177–8.

G. punctatum, β acerifolium, Guill. et Perr. = G. punctatum, *Sch. et Thon.*, 271.

GOSSYPIUM PUNCTATUM, *Sch. et Thon.*, var. JAMAICA, *Watt*, 170.

GOSSYPIUM PUNCTATUM, *Sch.*

et Thon., var. NIGERIA, *Watt*, 170.

GOSSYPIUM PUNCTATUM, *Sch. et Thon.*, var. PROSTRATA, *Watt*, 174.

G. punctatum, *Richard* = G. herbaceum, *Linn.*, 156.

G. puniceum, *Jacq.* = G. arboreum, *Linn.*, var. sanguinea, *Watt*, 91.

GOSSYPIUM PURPURASCENS: *DC.; Macf.; Royle; Anderss.; Tod.*; = G. purpurascens, *Poir.*, 250.

G. purpurascens, *Hook.* = G. Darwinii, *Watt*, 68.

G. racemosum: Poir.; DC.; *Tod.* (text 268–70 non tt.); = G. purpurascens, *Poir.*, 250, 253.

G. racemosum, *Tod.* (t. IX. & t. XII. f. 35) = G. brasiliense, *Macf.*, 295.

G. religiosum, *A. Gray* = G. tomentosum, *Nutt.*, 69.

G. religiosum: (non Linn.) *Lamk.*; *Cav.* (in part); *Swartz.; Willd.; Parl.* (in part); *Schum.* (in part); *Heuzé; Aliotta* (in part); = G. brasiliense, *Macf.*, 295–6.

G. RELIGIOSUM: *Linn.; Cav.* (in part); *Roxb.; Small*; = G. hirsutum, *Linn.*, var. religiosa, *Watt*, 201.

G. religiosum, *Parl.* (in part) = G. peruvianum, *Cav.*, 213.

G. religiosum, *Schum.* (in part) also *Aliotta* (in part) = G. vitifolium, *Lamk.*, 256.

G. religiosum: Solander; Hilleb.; *Wight & Arn.* (Prod. Fl. Pen. Ind. Or., 55 in part): = G. taitense, *Parl.*, 248.

G. Rhorii (*Rohrii*), *Tod.* = G. punctatum, *Sch. et Thon.*, 169.

GOSSYPIUM ROBINSONI: *Tod.*; = G. Robinsoni, *F. v. M.*, 67.

G. roseum, *Gammie* = G. arboreum, *Linn.*, var. neglecta, *Watt*, 96.

G. ROSEUM, TOD.; C. MUELL (in *Walp. Ann.*),; ALIOTTA; = G. arboreum, *Linn.*, var. rosea, *Watt*, 112.

G. Roxburghii, *Tod.* = G. arboreum, *Linn.*, var. neglecta, *Watt*, 96, 103.

G. rubrum, *Forsk.* = G. arboreum, *Linn.*, 15, 82, 161.

G. RUBICUNDUM, ROXB. *MS.* = G. Nanking, *Meyen*, var. rubicunda, *Watt*, 117, 127, 141, 226; *see also* App. 'A' under Wallichian Collections, n. 1,880 B.

G. sandwicense, *Parl.* = G. tomentosum, *Nutt.*, 69.

G. SANGUINEUM: HASSKL.; TOD.; = G. arboreum, *Linn.*, var. sanguinea, *Watt*, 87.

GOSSYPIUM SCHOTTII, *Watt*, 206.

G. semine virescente (green-seeded cotton) = G. hirsutum, *Linn.*, 183, 187–8.

G. siamense, *Tussac* = G. Nanking, *Meyen*, 114.

GOSSYPIUM STOCKSII: *Cooke; Talbot; Bent; Gammie* = G. Stocksii, *M. Mast.*, 73–4.

GOSSYPIUM STURTII: *Parl.; Tod.; Benth. et Mueller; Moore and Betche; Maiden; Aliotta*; = G. Sturtii, *F. v. M.*, 63–4.

GOSSYPIUM TOMENTOSUM: *Hilleb.; Tod.*; = G. tomentosum, *Nutt.*, 69–70.

GOSSYPIUM TAITENSE: *Tod.*; *Vesque; Aliotta*; = G. taitense, *Parl.*, 248.

G. tricuspidatum: Lamk.; Poir.; = G. hirsutum, *Linn.*, var. religiosa, *Watt*, 201.

G. tricuspidatum, *Tussac* (t. 17) = G. vitifolium, *Lamk.*, 255.

G. Vaupelli, *Graham* = G. Nanking, *Meyen*, var. Roji, *Watt*, 134.

GOSSYPIUM VITIFOLIUM: *Cav.* (in part); *Willd.; Poir.; DC.* (in part); *Saint-Hilaire; Richard; Royle; Tod.* (in part); = G. vitifolium, *Lamk.*, 255–6.

G. viridescens, *Buch.-Ham. MS.* (both varieties) = G. arboreum, *Linn.*, var. neglecta, *Watt*, 90, 93–4, 96, 98–9.

G. WIGHTIANUM, TOD. = G. obtusifolium, *Roxb.*, var. Wightiana, *Watt*, 143.

Sturtia Gossypioides, *R. Br.* = G. Sturtii, *F. v. M.*, 63.

Xylon Americanum præstantissimum semine virescente, *Miller* = Green-seeded cotton of Miller or G. hirsutum, *Linn.*, 183, 186; (cf. with G. præstantissimum, *Linn.*).

Xylon arboreum, *Merian* = G. vitifolium, *Lamk.*, 255.

Xylon brasilianum, *Jacob Zanoni* = G. brasiliense, *Macf.*, 300.

Ychcaxihuitl of Hernandez = G. vitifolium, *Lamk.*, 255.

INDEX

EXCLUDING NAMES OF AUTHORS AND TITLES OF THEIR WORKS, &c., ALSO THE CITATIONS OF SPECIMENS AND SYNONYMS, ALL OF WHICH WILL BE FOUND IN THE APPENDIX—LISTS A, B, AND C.

Abassi = White Egyptian cotton, 166, 214, 221, 224; original stock of, 214; earlier than Jannovitch, 220; cultivation in Egypt, 221, 224; origin of, 223; in India, 225; cross-references, 182, 185, 221, 293

Abbeokuta: *see* Lagos

ABUTILON, 52, 53

Abyssinia and Abyssinian cottons, 14, 84, 92, 122, 131–2, 135, 157, 173, 228; indigenous, 158; cross-reference, 323

Acclimatisation and acclimatised forms, 6, 100, 102, 249, 327–8; of *assamica*, 109; of *obtusifolium*, 139; of *punctatum*, 169; of *hirsutum*, 190, 199; of *purpurascens*, 251, 254; of *barbadense*, 273, 275–80; of *brasiliense*, 298, 306, 311, 314–5. *See* Feral

Acid purification, 39

ADANSONIA, 53; pollen-grains of, 345

Afghan cotton, 46, 117, 126–7, 156, 157; Ushtarzai, 97

Africa and African cottons, species and races, 83, 92, 97, 117, 118, 128, 131, 135, 138, 140, 143, 153–5, 169–81, 183, 196–8, 201, 211, 214, 215, 227, 228, 251, 252, 258, 268, 293, 298, 299, 311, 316; influence on American cotton, 18; indigenous green-seeded cotton, 22; goods, 17, 60; wild and indigenous, 91, 154, 169, 171, 311, 317; herbaceous cottons, 154; geographical groups of cottons, 155; association of *G. peruvianum* with, 166; length of staple, 176; Uplands *versus* Egyptian in, 180; prospects of future cultivation in, 175; influence of *G. Kirkii* on, 246, 317; recent successes in, 293. *See* East Africa; South Africa; West Africa, also under chief countries, *e.g.* Angola, Ashanti, Congo, Gold Coast, Lagos, Liberia, Nigeria, Senegambia, Sierra Leone, Togo, Zambesi, Zanzibar, &c.

Agra and Oudh, United Provinces of, 95, 144; Moradabad, 97; Kheri, 97; Meerut, 98; Gorakhpur, 127; Saharanpur, 110, 131, 171, 185, 202, 258; Banda, 131

Agriculture, importance in, 9; defective, 33; triumph of, 322. *See* Cultivation

Ahmedpur: *see* Deccan

Akese cotton, 92

Akola: *see* Nagpur and Berar

Alabama, cotton of, 169, 170, 181, 185, 192

Albania, cotton of, 158

Albash or Abyssinia, 14

ALBUM = white or fuzzy-seeded cotton, 248

Alexander, Dr. C. A. (1870), 100

Algiers, cotton of, 157, 158

Algodao do governo cotton, *Algodao macaco*, *Algodao pardo*, *Algodoi*, *Algodoim*, 309

'Allen,' a special race of cotton, 235; 'hybrid' and 'improved,' 239

'*Algodoeiro selvagem*,' wild kidney cotton, 308

Alps and Pyrenees, cotton cultivation on, 159

Althæa, 53; *A. cannabina*, 52; pollen of, 345, 349; *A. rosea*, 349

Amanihú of the Upper Amazonas, *Amanijú* of the Tupis, *Amany-ri* of the Caynas, 296

Amazons, cotton of, 256, 304

Amballa: *see* Panjab

Ambli (Dhollera) race of Indian cotton, 148

Ameniiou and *Bombasin* of Lerius, 295–6, 303

America and American (United States) cottons, discovery of cotton in, 17, 18; early attempts at cultivation in, 18, 19, 20, 21, 22, 81, 101, 184, 188, 192, 195, 230, 272, 286, 307;

influence of Civil War, 23; species, races, &c. (wild and cultivated), 65, 70, 73, 98, 100–1, 117, 118, 123, 124, 156, 157, 160, 162, 165, 167, 169, 170, 181, 183, 194–96, 201, 204–10, 211, 214, 215, 217–19, 224, 226–39, 241, 252, 254, 256, 259–65, 268, 272, 275–90, 296, 302–10; early knowledge in Europe of, 18; grades of, 45, 48; trade terms of, 47; *see G. herbaceum*; fuzzy-seeded, 165–7, 320; wild: *see under* Indigenous; St. Louis, Cottons of, 202; Uplands in Africa, 175–81; *Okra*: *which see*; Uplands in America, 192–6, 231–9, *see* Stocks, also Uplands; in India to-day, 198–200; Uplands in W. Indies, 239; Uplands in Russia, 239–41; historic records of kidney, 307; hybridised, 337; *see* Hybrids; introduction of Sea Island, 271–3: early importance of Charleston, 278–9. *See* App. A; *also under* names of states and countries, *i.e.* California, Carolina, &c.

America, Central: *see under* chief countries, *i.e.* Costa Rica, Guatemala, Honduras, Mexico, Nicaragua, Panama, Yucatan, &c.

America, South: *see under* names of chief countries, *i.e.* Argentine, Brazil, Bolivia, Colombia, Ecuador, Guiana, Paraguay, Venezuela, Uruguay, &c.

Aminiin of Marcgraf, 295, 296

Amonyiom of Claude d'Abbeville, 296

Amraoti: *see* Oomras

Andaman Islands, cotton of, 251, 294

Andes, cotton of the, 214, 218, 219

Angola, cotton of, 169, 171, 211, 252, 268, 311; Sange, 171. *See also* West Africa

Annual cottons, 15, 77, 87, 108, 115, 124, 126–7, 136–7, 143, 156, 159, 266, 278, 286, 309, 315, 322, 323; a late discovery, 15, 162; first great annual cotton, 80, 322; races of, 90; *versus* perennial, advantages of, 132, 136, 315, 321, 322; a recent development, 136–7; stocks necessary, 264; of Barbados, 268; Sea Island, stock of, 278; climatic influence on, 322; great stocks in Asia Minor, 322; in India, 323. *See* Perennial, *also* Tree Cottons

Anomalous genus, 4

Antilles, cotton of, 101, 144, 189, 207, 247, 254, 256, 257, 259, 264, 267, 287, 298; St. Vincent (Windward Islands), 299; Guadeloupe, *which see*

Anum: *see* Gold Coast

Aoki: *see* Japan

Arabia and Arabian cotton, 15, 43, 74, 75, 83, 92, 116, 128, 156, 157, 161; perennial, 13; wild (Dhofar), 63, 73–6; in ancient times, 86; Hadramout cultivation of *Roji*, 135; cultivation of *G. herbaceum*, 161; centre of influence, 323

Areas of cotton production of the world, 15–6, 60, 63, 80–1, 158–9, 165–7, 245–8, 316, 319, 322–7; of Indian races, 132–4, 147–8

Argentine, cottons of, 258; Buenos Ayres, 216

Arizona, cottons of, 169, 170, 181, 192

Arkansas, cotton of, 232

Arkwright, inventions of, 19–20

Armenia, cottons of, 228; conveyed to, 16, 157, 158

Aschabad: *see* Transcaucasia

Ashanti, cotton of, 215; Sittam, 258

Ashmouni (Egyptian) cotton, 210, 214 219, 223; of some writers, 214; original stock of, 214; origin, distribution, and yield of, 220; in India, 225; of Egypt (oldest variety cultivated to-day), 313

Asia and Asiatic cottons, 80, 116, 122, 125, 157; cotton conveyed to, 16; races of, 73, 122; important, 81; conveyed to New World, 81; and Jamaica early tree cottons, 81, 134, 216; varieties and species, 88; inferior grades of, 102; 'Asiatic cottons' of former writers, 165; indigenous seeds of, 320; three great species of, 323. *See also* China, India, Japan, Malay, Siam, &c.

Asia, Central (Tartary, &c.): *see* Yarkand

Asia Minor (Turkey in Asia), Cottons of: *see* Armenia, Constantinople, Damascus, Kurdistan, Levant, Mesopotamia, Palestine, Smyrna, Syria, Turkey, &c.

Assam, cotton of, 108, 109, 252; 'Assam Hill cotton,' 111, 336; 'Mikur' and Manipur, 129; Cachar, 98. *See* Garo hill cotton; *also Kil*.

Asul deshi and *lalio*, 150

Asvatayana Srauta Sútra, 9

Athens: *see* Greece

Aurungs, 106

Australia and Australian cotton, 4, 43, 46, 68, 145; wild, 63; Barrier Range, 65

Ava: *see* Burma

Badagry: *see* Lagos

Badi cotton, 202

Badminton: *see* Beaufort, Duchess of

Bagai cotton, 125

Bahamas, cotton conveyed to Georgia from, 20

Bahia, cotton of, 296, 299; cultivation of, 17; in Egypt, 313; cross reference, 45. *See also* Brazil.

Bahmia, 221
Bahr-el-Ghazul: *see* Soudan
Bairati kapas, 104, 105, 107
Bajwara, 82
Balls, W. L., described Senaar tree cotton, 114; remarks on 'Hindi weed,' 182; crossing experiments of, 339. For list of collections *see* App. A under Egypt.
Banda: *see* Agra and Oudh.
Banga cotton, 93
Bangai cotton, 112
Bani (Hinganghat and Oomra) cottons, 46, 131–4; origin of *varadi* and *vilayati*, 111, 113, 133, 151; of Berar, 124; origin of, 132; position of by former writers, 132; best breeding stock, 133; confirmed as a distinct variety, 134; as a hybridising stock, important element of, 337; cross references to, 96, 110, 111, 112, 118, 119, 122, 123, 128, 130, 152
'Banks,' trade name, 238
Banks, Sir J. (1782), 185
Ban-kukri cotton, 298, 314
Barbados and Barbados cotton, 22, 190, 228, 256, 264, 268, 269, 270, 272, 285, 287, 299; seed carried to America from, 19; oldest specimen of, 270; naturally grown, 271; equal to Sea Island, 280, 285. *See also* West Indies
Barberton: *see* South Africa
Barcelona, Cotton industry flourishing in, 15
Barlow, J. R., remarks on West Indies cotton, 291
Baroda, cottons of, 84, 92, 135, 150. *See also* Gujarat
Barrier Range: *see* Australia
Batoka: *see* Zambesi
Bazac (cotton of Jerusalem): *see* Palestine
Bazazulu of the Zambesi, 214, 215
Beaufort, Duchess of, Badminton Gardens, 184, 186–7, 228. *See* App. A under Sloane
Beaumont: *see* Europe, *also* France
Behar, cottons of, 131. *See also* Bengal
Belaiti or *bilati*, 46, 96, 97, 98, 109, 151
Belgaum: *see* Deccan
Bell, invention of, 19
Beluchistan, 157
'Bendeis,' trade name, 45
Benecke, Dr., sugar-cane improvement, 340
Bengal and Bengal cottons, 95–108; production and manufacture of, 13; of nineteenth century, 93 Serampore (cotton grown at), 98; plants and Japanese stocks compared, 102, 103, 104; 'Bengals' of commerce, 113; Dacca, 102–8; Dacca muslin, 12, 107; Dacca hand-spinning and moisture, 37; description of Roxburgh's picture of Dacca cotton, 103; Dacca short staple, 104, 105, 106, 107; Dacca cotton, early and recent opinions of, 103–7; Dacca hand-spinning *versus* machine, 106, 107; Dacca cotton, future investigations of, 107; Dacca industry 2,000 years ago, 108; Calcutta, 108, 117, 127, 141, 149, 150, 152–3, 172, 207, 252, 256, 268, 295, 339 (*see* Appendix A); Pabna, 251; Sibgunj (E. Beng.), 252; Sibpur, Calcutta, 252; Sikkim, *see* App. A under Hooker, as also Thomson; cross references, 29, 97, 99, 101, 119, 228, 252
Berar: *see Bani*, also Nagpur
Berbiche—a kidney cotton, 296
'Berry Big Boll,' trade name, 237. *See also* Staple
Bhalia cotton, 150
Bharadvaji, 9
Bhoglla, 132
'Bhownuggar,' trade name, 46. *See* Kathiawar
Bhutan, cotton of, 125, 252
'Big Boll,' trade name, 238
'Bismarck-braun,' 343
Bolivia (Cochabamba), Cottons of, 216; seed sent to India in 1781–90, 304, 314
BOMBACEÆ, 53, 56
BOMBAX, 12, 52, 53, 59, 135; *B. religiosum*, 204
Bombay cottons: *see* Broach, Concan, Deccan, Dharwar, Gujarat, Kathiawar, Khandesh, India, &c.
Borkapah cotton, 108
Borneo (N.), cotton of, 298, 299
Boshveld: *see* South Africa
Botany, practical bearings of, 3; the basis for successful experiment, 3; rule of priority, 5; botanical knowledge important, 342
Bote (N.): *see* East Africa
Bourbon cottons, 250–5; origin of name, &c., 247; of Royle, 250; origin of, 253; distribution of, by French, 254; failure in Bombay, 254; in South America, 254; form of, 261; position of, 266; confusion of, 325, 326; cross references, 7, 46, 151, 152, 174, 228, 249, 262, 266, 272, 326. [For early report on Cultivation in Bourbon, *see* E.I.C. volume of Reports, &c., 1836, 385–97]
'Boweds,' trade name, 45
'Boyd,' trade name, 238
Bracteoles, peculiarities of, value in classification, &c., 7, 54, 55, 80, 244

Bractlets, 54, 59, 65, 241–2, 257
Bradbury, T. C. (of Gartside & Co., Manchester), 37
'Bragg Long Staple,' trade name, 193
Brazil and Brazilian cottons, 295–315; 168, 211, 252, 296, 298, 299, 301, 302, 307–8; appeared in England before cotton of U.S., 20; grades of, 45; quality terms, 47; and Jamaican plants described, 161; wild, 167, 308; *quebadinho* cotton, 256, 296, 309; plant of Marcgraf, 259; Bahia, *which see*; Ceara, *which see*; Maragan, *which see*; Pernambuco, *which see*; Rio de Janeiro, 299; early writers on, 300; of to-day, 301; antiquity of cultivation, 304; first exports from, 303; in Scotch and English markets, 307; in United States, 307; of Koster, 307: climate of, 308; acclimatisation of Sea Island in, 310; origin of, and lost popularity of, 326; cultivation neglected, 327; cross references, 17, 18, 264, 311
British Cotton Growing Association, 106, 179; British cotton and linen manufactures, 19; British Possessions, expert cotton-growers sent to, 180
Broach cottons, 46, 140; *deshi*, 148; or Surat *deshi* grown on poor soil, 150. *See* Bombay; *also* Gujerat
'Brown,' trade name, 45
Brown, Col. (1789), 276
'Brown Bearded Cotton' of Edwards, 250
Bruun-á in the Amazonas, 296
Buckrams, 14
Buenos Ayres: *see* Argentine
'Bumbast' cotton, 14
Burada cotton (Ind. vern. syn. for Nadam, *which see*)
Burden, Mrs. K., attempted cultivation of *G. vitifolium* in S. Carolina in 1786, 20
Burling, Walter, introduced Mexican cotton to Mississippi, 21, 192
Burma, Cottons of, 93, 116, 128, 144, 172, 323; Rangoon, 46, 129; Ava, 129, 296, 301. *See* App. A under Brandis, Burkill, Griffith, Wallich, &c.

Cachar: *see* Assam
Cagliari: *see* Sardinia; *also* Europe
Calabria, cotton of, 46. *See* Europe
Calcutta: *see* Bengal
Calicos, printing securely established, 21; of Masulia, 12; British, 21
Calicut, garments of people of (ninth century), 13. *See* Madras
California and Californian wild cottons, 43, 63, 65–7, 70, 73. *See* America; *also* Cerros Islands
CALOTROPIS, 12
Camard, Arruda da, 308
Cambay: *see* Gujarat
Cambodia: *see* Siam
Canara (Kanara): *see* Deccan
Canary Islands (Teneriffe), 211
Capas of Rumphius, 114
Cape of Good Hope: *see* South Africa
Carbasa (*carbasus*), 9, 10, 11, 12
Carmen Island: *see* Mexico
Caroco cotton of Brazil, 309
Carolina cotton, cultivation started 1733, 19, 185; earliest specimens from, 184; seed from S. Carolina, 278. *See* America (U.S.), also Charleston
Carpasus: *see Carbasa*
'Carthagena' (Cartagena) cotton, 46; with 'big boll,' 109. *See* Colombia
Cartwright, discoveries by, 19
Cassas, 14
Caspian area, 323
Cayenne cotton, Guiana, French, *which see also under* Surinam
Ceara cotton, 45, 168, 299. *See* Brazil
Celebes cotton, 116, 131, 257; of Rumphius, 257; of Lamarck, 260. *See also* Malay
Central Provinces of India: *see* Nagpur, *also Bani* cottons
Cephalonia (Ionian Islands): *see* Greece
Cerros Island (Lower California), wild cotton of, 63, 66
Ceylon cotton, 84, 126, 127, 139, 140, 147, 257
CIENFUEGOSIA PENTAPHYLLA, Schum., 132
'Chaco Cluster,' trade name, 232
'Chain Cotton': *see* Kidney, *also G. brasiliense*
Chamba: *see* Panjab
Chanduy: *see* Peru
Charara (Egyptian) cotton, 292
Charleston (South Carolina), early exportation of cotton from, 20; emporium of Sea Island, 278–9
Chatham Island: *see* Galapagos
'Cheise,' trade name, 238
Chelsea Physic Gardens, cotton grown at, 98, 184, 186–7. *See* England
Chemistry: *see* Fibre
China and Chinese cotton, 114–139; 81, 83, 97, 98, 127, 184, 298; eleventh to thirteenth century introduction of cultivation, 13, 118. 123, 323; grades in trade of, 46; Shanghai, 98, 116, 132, 185; Yunan, 116; Pekin, 116, 117, 121; Yangtzekiang, 116; Macao, 117; introduction into Bengal from, 118; Pakhoi,, 185

Chintzes, 14
'Christopher,' trade name, 238
Classification of Gossypium, 3, 7, 52–60; **Section I.**, 61–77; **Section II.**, 77–163; **Section III.**, 163–244; **Section IV.**, 244–315; **Section V.**, 316–318; based on structural peculiarities of wild species, 7, 8, 60, 62, 319, 321, 322–7; on seed and floss, 7, 27, 41–9, 55, 56, 62, 208, 319; on the presence, position and nature of glands, 56–9; on the shape, degree of union, &c., of the bracteoles, 61–3, 77–81, 163–67, 244–48, 316, 342; on the study of pollen grains, 62; adopted by cotton growers, 230; into two or more species: *see under* Gossypium *below*
Clark, W. A.; James Island plantation system, 283
Climate, climatic conditions and forms; environment, 3, 328; increased temperature, 50; sports, 89; influence on races of *G. arboreum*, 91; on insular and continental production, 275, 285, 310; of Sea Island, 275, 288; too much rainfall, 288; of kidney cotton country, 308, 310; 'climatic varieties,' 341
Cluster and semi-cluster cottons: *see* Staple, *also* Uplands
Coahuila: *see* Mexico
'Cobweb,' trade name, 193, 239
Cochabamba cottons: *see* Bolivia
'Coconada': *see* Madras
Coelho: Duarte Abuquerque, 303
Coimbatore: *see* Madras
Colbiorson, M., cotton furnished in 1790 by, 263
Colombia or New Granada (Carthagena), cottons of, 46, 109, 168, 216
Columbus, no description of plants seen by, 18
Commerce, trade, commercial enterprise and influence of cotton central feature of modern, 9; early traffic in cotton, 12–16, 17, 46, 160; ancient trades decayed and repaired again, 18; exports from America seized in Liverpool, 20, 160; American exports in eighteenth and nineteenth centuries, 21, 272, 286; first cotton duty, 21; cotton famine and effects on industry, 23, 24; exports from India to Great Britain, 21; cotton supremacy of England threatened, 24; trade requirements and standards, 30, 45–51; lowest English market quality, 47; contracts—'Futures,' 50–1; Indian Cotton Frauds Act and adulteration, 199; transport difficulty, 180; retrograde traffic, 200; Indian cotton trade restricted, 200; foreign market for Indian low grade, 255; 'trade' by Poiret in 1818, 264; cultivation in British West Indies, 273, 278, 285, 291–2; early exports from Charleston, 278–9; cotton employed as money, 303. *See under* Industry
Comptah (*coomptas*), commercial spellings of Kumpta, *which see*
Compton, Mr., 19
Concan, cotton of, 298. *See* Bombay
Congo, cotton of, 214, 215. *See* Africa, West
Conquistadores, 219
Constantinople, cotton conveyed to, by the Saracens, 16. *See* Asia Minor
'Cook,' trade name, 239
Coorg: *see* Mysore
Corbett, Sir V., remarks on crop condition and yield in Egypt, 222
CORCHORUS, 52
Cossipium, 11
Costa Rica, cotton of, 216, 299; 'Costa Rica,' 169, 170, 296. *See* America, Central
'Cotonier de Géorgié,' 258
'Coton Indien' and 'Coton Siam' of Rohr, 250, 350
'Coton-pierre,' 296
Cotton, earliest mention of, 1, 2, 3, 9, 10–14; contrasted with silk and hemp, 9, 59; important inquiries into, 2; position in classic literature, &c., 9; derivation of word, 10; used to quilt beds, 14; of fifteenth century, 16; of sixteenth century, 17, 161; of seventeenth century, 18; of eighteenth century, 19; of nineteenth century, 21; of twentieth century, 24; used by Egyptian priests, 85; species first cultivated in Europe, position in twelfth century, 158; goods, British effect of, 197; high yield of worthless staple, 200; essentially a modern cotton, 227
Counts: *see* Fibre
Craven, Earl of, 160
Crete, cotton cultivation in, 157–8, 159. *See* Europe
Crimea, cotton cultivation in, 16, 158. *See* Europe
Criollo or *creole* cotton, 218
Crioulo cotton, description of, 296, 308, 309
Crosses and crossing: *see* Hybrids and Hybridisation
Cuba: *see* West Indies
Cuda pariti, 15, 95, 99; paretty, 116
Cultivation and cultivated cottons, chief points of interest to planters, 2; properties of the cell, 26–34; classification of staples and trade standards, 41–51; structural peculiarities of plants, 54–60; *arboreum*,

87–91; **Dacca**, 104–7; *assamica*, 109–112; *Nanking*, 122–4; *himalayana*, 125; *Nadam*, 128–9; *Bani*, 131–4; *Roji*, 137; *soudanensis*, 138; *Wightiana*, 147–53; *africana*, 154–5; *herbaceum*, 159–63; *punctatum*, 174–182; *hirsutum*, 190–200; *religiosa*, 201–4; *Schottii*, 209; *microcarpum*, 213; *peruvianum*, 217–26; *mexicanum*, 230–44; *purpurascens*, 254–255; *vitifolium*, 261–5; Sea Island, 275–95; *brasiliense*, 302–15; geographically, *see under* names of countries concerned; effects of, 8, 40, 59–60, 191, 253, 305–7, 324, 332–5, 350; early (350 B.C.), 11; seasons of growth and harvest, &c., 29–30, 33, 50; survivals of former cultivation, 102; early and late maturity plants, 151, 181, 233, 238–9, 286–9, 305, 336; pruned, *see* Ratooned; result of neglect in, 306; variability of forms, 229–30; chief areas of, 246–7, 319, 322–7; weeding, 389

'Culpepper,' trade name, 237–8

'Cummings,' trade name, 237–8

Cuprammonia or cuoxam, 39

'Curaçao' Island (Venezuela) of Rohr, 120, 168, 169, 170, 333, 334

Cyprus, Cultivation in and exports from, 15, 17, 159. *See* Europe

Cytological research, 339–40

Dabalio, 152

Dacca cotton: *see* Bengal

Dahomé, yellow Siam cotton of, 175. *See* Africa (West)

Damascus, cotton cultivation of, 159, 160. *See* Asia Minor

Damietta: *see* Egypt

Dardanelles, 158. *See* Europe

Dar-es-Salaam: *see* Zambesi

'Dead' or 'Kempy' cotton: *see* Fibre

Deccan and Khandesh (*also* Maratha Country), cottons of, cultivated, 122, 125, 128–131; hemp, 52; **wild**, 142; **Belgaum**, 145; Canara, 252; **Dharwar** (saw-ginned) cotton, 22, 46, 134, 183, 198–9; **Khandesh**, 46, 96, 113. *See* Bombay, *also G. hirsutum* and Uplands

De Foe, Daniel: dispute with East India Company, 19

Degeneration of cotton, 137, 147, 191 (*G. hirsutum*), 199, 200, 222, 275, 282 (Sea Island), 285, 288, 306, 320, 328–9

Delagoa Bay: *see* South Africa

Demerara, British Guiana, *which see*

Deo kapas, 82, 202; *dev*, 93; *dyva nerma*, 95

Deshi (*desi*), 97, 98, 132, 133, 149, 150; deshila, 132; *deshi* of Broach, 151, 335; *deshi amod*, 152; *deshi* Broach × *bani*, 336

Dev-kapas; *see Deo*

Dharwar: *see* Deccan

Dhofar cotton: *see* Arabia

Dholca: *see* Gujarat

Dhollera ('Dhollerah'): *see* Kathiawar

DICELLOSTYLES, 73

Diego Garcia: *see* Polynesia

Diseases of the cotton plant: **weevil**, 241, 242, 243; **wilt**, 283, 331; **immune** to, 243, 256, 307, 310; **remedies** for, 285, 330–1; localities where weevil unknown, 319; cross-references, 21, 241, 243, 319

Dominica. *See* West Indies

'Doughty,' trade name, 239

'Drake,' trade name, 238

'Drake's Cluster,' trade name, 232

DRYNARIA, 72

Dumroy (Eastern Bengal), water and thread of, 106

'Duncan,' trade name, 238: 'Duncan's Mammoth Prolific,' 241

Dunkan, Dr. P. (associate of Rohr), 262, 264, 305

Dupoy, M., cultivation of cotton on Lower Alps, 159

'Durango,' trade name,' 231

DURIO, 53

Dwarf Cotton. *See Rasteiro*

'*Dyva Nerma Capass.*' *See Deo*

Early maturity plants. *See* Cultivation

Early Small Boll Series. *See* Staple

East Africa, British, cottons of; **Lake Rudolf** cottons, 171; **Nyassaland**, 153, 171, 196–7, 211, 298, 311; **Somali Coast**, 215; **Tanganika**, 298, 311; **Malindi** (wild), 317; **Mundane Hills**, 317; **N. Bote** (wild), 317; **Mombassa**, 317

East India Company, efforts to improve cotton in India, 19, 20, 22, 23; resentment of Dr. Hove's mission, 20; enterprise of, 313–4

Eastern Bengal and Assam. *See* Assam, *also* Bengal

Economic importance of cotton, 9; economic properties, 52

Ecuador (S. America), cotton of, 258

Edisto Island, cotton of, 45; Sea Island in, 277. *See G. barbadense, var. maritima*

Edson, Mr. A. W., *okra* cotton, 233

Egypt and Egyptian cotton (*G. peruvianum, which see*), 113, 123, 138, 154, 159, 166, 170–71, 181–2, 183, 198, 201, 212, 215, 219–24, 224, 242, 251, 257, 258, 266, 268, 275–6, 292–3, 312–3; cultivation in **thirteenth century**,

14–5; imported cotton, 15, 159: improvement in, 22; compulsory cultivation of Jumel's cotton in, 22, 312; grade names of, 45, 47; passage in Virgil regarding cotton in, also cultivation in fourteenth century, 86, 157; Senaar, *see* Tree Cotton; Suakim, 154; Soudan, *which see*; herbaceous cotton in, 157–9; cotton brought by Jumel (*G. brasiliense*) to, 166, 219, 220, 221, 224, 312–3; cultivation but no record of introduction of *afifi*, *abassi*, &c., 166–7, 219, 224, 276; early maturity in, 181; old examples mainly *G. hirsutum* in, 185; early indigenous cotton spoken of, 219, 220; the 'Hindi Weed,' 169, 171, 182, 221, 223, 313; Sea Island in, 220, 221, 223, 278, 292 (Gallini); degeneration of, 222; ashmouni the oldest Egyptian cotton, 223; Mr. Ball's specimens, *see* App. A, descriptive notes on, 224; species best suited to, 256; *G. vitifolium* (some of the long staple of Egypt), 256, possibly include Jannovitch, 222; Damietta, 268; cross references, 22, 34, 83, 85, 169, 197, 215, 225, 267. *See* Peruvian, *also* '*Abassi*,' '*Ashmouni*,' '*Mit afifi*,' 'Gallini,' 'Hindi Weed,' 'Jannovitch,' 'Jumel,' &c., &c., in their alphabetical positions

Elder. *See* Australia

Elliott, Mr., endeavour to cultivate black-seeded cotton in 1790, 20, 176

'Ellis,' trade name, 238

England (Great Britain), 'Manchester cottons,' 12, 17; cotton conveyed to, 'Politie of Keeping the Sea,' 1430, A.D., 16; supremacy threatened, 24; imported cotton goods, 17, 18; imported raw fibre from the Levant, 17, 18, 19, 20, 313, 323; woollen manufactures, defence of, 18, 19; a cotton manufacturing country in 1635, 18; imported raw cotton from United States, 20; imported raw cotton from India, 20, 24; muslins and high counts first produced, 1782, in, 20, 22, 189; trade terms in, 48; cottons grown at Chelsea, at Badminton, and at Daventry, 186–8, 191, 336; from Brazil, 326. *See* Hybrids under Clarke

ERIODENDRON, 12, 52, 53; *E. anfractuosum*, 10

Errapathi chettu, an Indian cotton. *See* Nadam, *also* Madras

'Essequibo' cotton, 296

Europe (*see* Calabria [Italy], Crete, Cyprus, France, Greece, Naples, Sardinia, Spain, &c.): early cultivation in, 16, 158, 184, 300; *G. herbaceum* first species cultivated in, 158–60, 323; cultivation of *G. hirsutum* in, 184; Naples, 211; kidney cotton in, 300; Brazilian cotton imported into, 326. *See* Levantine, *also* Roman Cotton

Evolution, 2, 331

'Excelsior,' trade name, 238

Experiments with cotton, effects of ignorant, 2; by Rohr, 103; in the Transvaal, 198; in Africa, 170–80, 293; in India with Egyptian races, 182, 225; with Sea Island, 293; danger of experiment with unstable forms, 351. *See* Hybrids and Hybridisation, *also* Improvement of Cotton

'Fair,' Definition of in America, 48

Feral states, 60, 182, 306. *See* Acclimatisation

Fernando Po (Island), West Africa, cotton of, 298

Fibre, The Cotton Wool: *see* Floss & Fuzz, *also* Staple, 25–51; classification of the floss or fibre, 6–7, 27, 32, 41–44, 56, 62; counts or lengths of yarn to pound of cotton, 22, 46, 284; history of discovery of, 9–12; prices of fibre, 21, 158, 176, 198, 225, 279, 292; comparison between Sea Island and Indian, 24, 36; grades, their merits and names, 24, 29–30, 42, 45–9, 102, 122, 132, 151, 154, 173, 247, 259, 268, 278, 283, 331; microscopic examination and structure of, 25–6 (*see* Rawson, &c., in App. B.); twisting of, 26, 28, 30, 34, 275, 298; irregularity in growth, 26, 27, 30, 50; metabolism of cell, 27; uniformity in length essential, 27, 31, 35, 200, 284; formation of cellulose, 27, 31–2, 38, 40; parts and contents of cell, 27–8, 30–1, 33–4, 298; unripe, mature and over-ripe cells, 28, 31, 33, 50; humidity (moisture) and swelling of, 28, 29, 37–8, 49–50, 101, 102–8; seasons of growth, 29; effect of climate on, 29–30; dead or kempy cotton, 32–34; wild *versus* cultivated, also effects of defective agriculture, 33; endochrome, 33; standard measurements of, length, thickness, &c., 34–6, 49, 271, 275, 284 (*see also* Rawson, &c. in App. B.); chemistry of cotton cell, 36–41; strength, elasticity and breaking strain of, 38, 40, 50, 284; mercerising of, 38, 222, 298 (*see also* Rawson in App. B.); increased weight in, 39; ruptured or torn from seed, 41, 43; empirical tests, 49–51; two coats of wool, 56; for Brahmical

string, 85; yield and percentage of lint, 89, 144, 213, 218, 221, 238, 239, 283, 285, 290, 298, 308, 330; low grade and high yield, 133; cleanliness essential, 284. *See* under Floss, *also* Kidney or Chain Cotton
Field Selection: *see* Stock.
Fiji Islands, cotton of, 45, 70–1, 201, 215, 275, 294, 298. *See also* Polynesia
'Fine Cotton,' 263.
Flax (linon), had the original meaning of cotton, 10
Fleeces (eiria), 10, 56
Fletcher, Mr. Fred., remarks regarding Egyptian cotton cultivation, 225
Florence Herbarium, 210
Florida, cottons of, 45, 170–1, 268; 'East Floridas,' 48, 49, 181, 201, 202, 243, 268, 277; Key West, 170–1
Floss and fuzz, 55–6; in wild species, 6, 7, 41, 44, 208, 249; in cultivated species, 8, 27, 208, 320; often called lint, 10, 40, 238, 284–5, 320; lengths of, 34–6; fuzz but not floss, 7, 43, 61, 62, 94; fuzzy-seeded cottons, 4, 7–8, 44, 56, 77, 80, 163–7, 174, 181, 209, 217, 245, 248, 278, 319; floss but not fuzz (naked or black-seeded cottons), 4, 8, 20, 21, 27, 43–4, 56, 152, 227, 244, 245–6, 248, 251, 257, 259, 260, 266, 297, 313, 316, 324–5, 333; removable and non-removable floss, 7, 27, 41, 43, 56, 62, 188, 244–6, 251, 257, 267, 275, 317, 320; greenish coloured fuzz (green-seeded cotton), 19, 20, 21, 135, 154, 183–4, 186–9, 192, 205, 210, 211, 214, 231, 236, 237, 263, 323; rust-coloured, red or brown (*khaki*), 7, 28, 33, 41, 42, 55, 64, 66, 70, 72, 75, 114, 116, 117, 118, 127, 129, 137, 140, 152, 154, 168, 169, 185, 201, 203, 206–7, 211, 214, 221, 224, 232, 233, 235, 237, 248, 251, 252, 254, 297, 306, 316–7 (generic type), 320; silky flosses, 82, 90, 132, 115, 125, 126, 149, 150, 169–70, 214, 221, 224, 233, 235, 236, 238, 250, 257, 266, 275, 284–5, 298, 300, 309; in FUGOSIA, THESPESIA and GOSSYPIUM, 55; in THURBERIA, lines the inner wall of capsule, 56; white and grey (ash) fuzz, 153, 157, 227, 231, 234, 235, 236, 237, 238; woolly flosses, 97, 108, 112, 150, 152, 205, 211, 224, 227, 231, 232, 234, 237, 238; rough floss, 45, 176, 210; wool mixing, cottons suitable for, 110, 210. *See under* Fibre, Kidney, Seed, &c.
Flowers, colour of (red or purple), 64, 72, 77, 78, 82, 89, 91–3, 95, 125, 126, 127; yellow with pink to purple claws, 66, 67, 68, 70, 73, 74, 77, 78, 79, 94, 97, 108, 124, 128, 129, 131, 134, 139, 153, 156, 170, 205, 211, 214, 316; yellow or white tinged with pink to purple, 67, 97, 112, 115, 128, 130, 131, 135, 168, 170, 184, 201, 205, 206, 227, 249, 251, 257, 267, 297; claws not possessed of purple spots, 67, 70, 184, 201, 205, 211, 227; petals dry into lemon-green in herbarium, 214
Foliage, shape and texture, 59, 163, 326; glabrous and semi-glabrous, 88, 193–4, 199, 247; softly hairy, 59, 88, 109, 131, 162, 193, 199, 229, 256
France, cotton of, 159; Montpelier, 269; Beaumont, 300
Frontispiece, description of, 260
FUGOSIA, 53, 54, 55; cotton closely allied to, 63; species of Gossypium structurally alike, 43
'Fully Good Middling' = F.G.M., 47
Fuzz: *see* Floss
Galapagos Islands, cotton of, 43, 63, 67, 282, 284; Chatham Island, 68
Gallini (Egyptian) race, origin of, &c., 45, 221, 222, 223, 275, 292
Galloway, Mr. B. T., 102, 194
Gambia: *see* Senegambia
Gametes, 111, 134, 326, 342, 350
Gangitiki, fine cotton cloth, 12
Gangri (a Kathiawar cotton), 132
Gapas cotton, 211
Garo hill cotton, cultivation, hybridisation, &c., 108, 110, 112, 118, 124, 133. *See* Assam
Geographical distribution of species: Section I., 63; Section II., 77; Section III., 165; Section IV., 244; Section V., 316; of two assemblages of cotton, 87–8; of forms of *G. Nanking*, 122–3; distribution of Sea Island, 287; and influence of slave traffic on kidney cotton, 311
Georgia and Georgian cotton, green-seeded cotton obtained from Chelsea in 1732 and grown 1734 in, 19, 186–8, 192, 194; first sample sent to England in 1741, 19; black seed introduced in, 20; Uplands of, 192, 200, 231–39; 'Georgia Cotton,' 195, 279; Georgia, Sea Island, or Long Staple Uplands, 195, 234, 239; Georgian cotton of Spruce, 183. *See also G. hirsutum*, Dharwar and Uplands, &c.
'Gibson,' trade name, 238
Gilgit, cotton of, 158, 172
Gins (saw), 8, 20, 43, 198; special, 188, 199; roller, 284; effect of steam gins, 329
Glands and nectaries, number and position of, &c., 7, 56–9, 61, 62; more

constant in *Gossypium* than in allied genera, 57 ; extra floral, 77, 163, 244, 316
Glasgow, former demand for kidney cotton in, 307
Goghari race, description of, 148–50; versus *Uppam*, 151; and *Wagria*, flosses of, 152. *See* Gujarat, *also* Kathiawar
Gold Coast cotton, cultivation and trade of, 171, 176, 178, 179, 185, 215. *See also* Africa, West
Gondal : *see* Gujarat *and* Kathiawar
Gongachora, cotton of, 93
'Good Middling,' = 'G.M.,' 47
'Good Ordinary' = 'G.O.,' 47
Goradu : *see* Soil
Gorakhpur : *see* Agra and Oudh
Gosse : *see* Australia
Gossampine,' 'Gossympines,' and *Gossypion* (cloth and wool), 11, 12, 59–60, 159, 304
GOSSYPIUM, characteristics of genus, &c., 52–60 ; number of species, 2, 4, 5 ; species of early botanists first made known, 3, 306 ; confusion of, 4 ; first picture of each species of, 6 ; allied genera compared, 55 ; separation of species of, 147 ; species used by sugar planters for lamp wicks, 189 ; reduction of species to one, 248, 274 ; by Hamilton to two or three, 2, 99, 203, 321 ; by Bentham and Hooker to three, 4 ; by Alliotta to five, 321, 332 ; by Todaro to fifty-four, 4, 321 ; by Parlatore to seven, 321 ; by Gammie (Indian species) to one, 5, 332 ; and by Evans (economic species) to five, 273–4 ; peculiarities of long acclimatised species, 320 ; imperfect knowledge of, 329
GOSSYPIUM ARBOREUM, *Linn.*, 81–114 ; *also* App. C, p. 379 ; not successfully acclimatised in New World, 81 ; varieties and races of, 87, 90–114 ; colour of type condition, 89 ; ancient cultivation of, 84, 90, 146, 322 ; wrong determination by Roxburgh, 99 ; of Africa, 155, 311, 328. Var. assamica, *Watt*, 108–112 ; value in hybridisation, 110–2. Var. neglecta, *Watt*, 95–108, early carried to America, 81 ; carried to West Indies, 81, 101 ; survival in America after 300 years, 101 ; Dacca cotton, 102–8 ; cultivation in East Africa, 155. Var. rosea, *Watt*, 112–114. Var. sanguinea, *Watt*, 91–5
GOSSYPIUM BARBADENSE, *Linn.*, 265–95 ; *also* App. C, p. 379 ; compared with *G. Davidsonii*, 69 ; Egyptian races of, 223 ; failure in Russian Turkestan, 240 ; diagnostic characters, 245, 266, 271 ; earliest stock possibly a cultivated state of *G. vitifolium*, 256, 261, 273, 281 ; special races of 264–5, 266–8, 281 ; geographical distribution of 267, 271 ; the type, 268–70, 325 ; Wright's story of production of annual stock, 271–2 ; cultivation in West Indies, 273, 305, 335 ; hybrids of, 274, 281, 332 ; in Madagascar, 293 ; and *G. brasiliense*, separation of, 297. Var. maritima, *Watt*, 275–95. *See also* Sea Island
GOSSYPIUM BRASILIENSE, *Macf.*, 295–315 ; *also* App. C, p. 380 ; a probable ancestor of Sea Island, 225 ; diagnostic characters of, 245 ; association with maritima, 277 ; habitat and distribution of, 246–7, 298 ; indigenous and feral states, 298, 304, 306, 308, 311–2, 328–9 ; early mention of, 161, 299–302, 322, 326 ; vern. and trade names for, 296, 300, 301, 308–9 ; types and pictures of, 300–2 ; in America, 302–10 ; in West Indies, 305–7, 335 ; in Malaya and Polynesia, 311 ; in Africa, 166, 300, 311–12, 328 ; in Egypt, 166, 312–13 ; in India, 167, 313–15 ; in Europe, 300, 306 ; displaced by Upland and Sea Island, 300 ; climate and soil best suited to, 310 ; immunity to disease, 310 ; confusion by Roxburgh, 314 ; compared with *G. Kirkii*, 317 ; hybrids and hybridisation of, 259, 306, 317, 325, 335 ; pollen-grains in, 346-7, 348. *See also under* Kidney Cotton
GOSSYPIUM DARWINII, *Watt*, 68–9
GOSSYPIUM DAVIDSONII, *Kellogg*, 65–66, 319
GOSSYPIUM DRYNARIOIDES, *Seem.*, 71–3
GOSSYPIUM FRUTICULOSUM, *Tod.*, 206 ; diagnostic characters of, 164 ; resemblance to *G. Palmeri*, 205
GOSSYPIUM HARKNESSII, *Brandg.*, 73 ; seeds of, 55, 319
GOSSYPIUM HERBACEUM, *Linn.*, 155–163 ; *also* App. C, p. 380 ; habitat and distribution of (Levantine cotton), 15, 16, 143, 157, 192, 322–3 ; trade names and grades, 46 ; cotton first grown in Europe, 158–9, 162 ; early in Russia, 158, 239 ; in Egypt, 159 ; in Abyssinia, 158 ; in Arabia, 158, 159, 161 ; in Asia Minor, 159–62 ; in United States, 160–3, 196, 338 ; not grown in India but in Afghanistan and Beluchistan, 146, 157 ; confused by Roxburgh, 162 ; inferior stock to green-seeded cotton, 187, and to vine-leaved, 259 ; separation from *G. microcarpum*, 211. *See also* Levantine cotton

GOSSYPIUM HIRSUTUM, *Linn.*, 183–200; *also* App. C, p. 381; mistakes made by certain writers, 119, 120, 274, 332; in Linn. herb. and in Linn. Sp. Pl., 140; Philip Miller's plant, 18, 186–9, 192, 196, 323–4; in New and Old Worlds, 184; diagnostic characters, 164, 184; vern. and trade names for, 183: habitat and distribution, 184, 190; type and early drawings of, 184, 186, 187, 189, 191; earliest cultivation known of, 187–9; hybridisation and selection, 162, 167, 190–1, 192–9, 231–9, 274; long staple Uplands, 234–5; degeneration of, 191; soil and climate for, 195; in United States, 192–6; in Africa, 179, 196–8; in India, 198–200; in Russian Turkey, 240; derived from *G. punctatum*, 165, 169, 174, 184, 191; *Riqueza* cotton, *which see*; in cultivation hardly separable from *G. mexicanum*, 227; British colonists associated with, 247, 324; two great forms of the cultivated *G. hirsutum*. *See also under* Green-seeded cotton, Uplands, New Orleans, Georgian short staple, &c., &c., 324. Var. **religiosa**, *Watt*, 201–204: diagnostic characters, 164, 201

GOSSYPIUM KIRKII, *M. Mast.*, 316–8; description of, 316; compared with *G. brasiliense*, 44, 317–8; the only absolutely naked-seeded cotton, 246, 320; future influence of, 246

GOSSYPIUM KLOTZSCHIANUM, *Andss.*, 61, 66–7

GOSSYPIUM LANCEOLATUM, *Tod.*, 210; description of, 164, 205, 209, 210

GOSSYPIUM MEXICANUM, *Tod.*, 226–244; *also* App. C, p. 382; diagnostic characters of, 165, 226; MS. drawings in B. M., 229; habitat and distribution of, 226–7, 324; no record of wild or feral states, 229, 230; hybrids, 167, 229, 230–9; Uplands in W. Indies, 239; in Russia, 239–41; weevil-resisting, 241–44; two great types, origin and description of, 167; and *G. purpurascens*, similarity of, 226, 227, 241; possible origin of, 230, 326; differs from Sea Island, 281. *See also* Uplands, Georgian and Mexican, &c.

GOSSYPIUM MICROCARPUM, *Tod.*, 210–13; *also* App. C, p. 382; description, 164, 210; origin of, 166–7, 326; wild condition of, 206; cultivation of, 213; seeds of, 217; large calyx of, 244; confusion with, 315

GOSSYPIUM MUSTELINUM, *Miers*, 167–8; description of, 163, 214

GOSSYPIUM NANKING, *Meyen*, 114–139; *also* App. C, p. 382; diagnostic characteristics of, 78, 115, 121, 142; types and plates of, 119; habitat and distribution of (wild state not recorded), 81, 116, 122, 323; cultivation by Rohr, 101; Linnean mistake, 119; cultivated in India, five forms, 122, 124; in Japan three forms, 123; in Trans-Caucasia, 124, 240; in Africa, 155; mistaken for Garo Hill, 124; naming of varieties and races, 130; stocks and hybrids of, 138–9; soils suited to, 147; mountain-loving species, 323; Var. **Bani**, *Watt*, 131–4; Var. **himalayana**, *Watt*, 124–26; Var. **Nadam**, *Watt*, 128–31; Var. **rubicunda**, *Watt*, 91, 121, 126–8, 141; Var. **Roji**, *Watt*, 134–7; Var. **soudanensis**, *Watt*, 79, 123, 138–9

GOSSYPIUM OBTUSIFOLIUM, *Roxb.*, 139–53, *also* App. C, p. 382; diagnostic characteristics, 79, 139–40, 141–2; wild forms of, 140, 142–3; **oldest specimens of**, 145; Deccan and Linnean, 143; habitat and geographical position of, 80, 140, 143, 147, 323; early knowledge of, 80; **soils** (black cotton) for, 147; perennial and annual plants, 80; Burkill's types confused with **rubicunda**, 117, 127, 141, 142; Indian cultivation and special forms of, 147, 153; in Africa, 155; hybrids of, 146, 151–3, 318; Gammie's view of this species, 332. Var. **africana**, *Watt*, 153–54; African cottons, 155; bractlets seen in one specimen, 242; from Senegal, 178. Var. **Wightiana**, *Watt*, 143–53; opinions of botanists, 145; hybrid stocks, 146, 151–3; Indian pure races of, 149–51

GOSSYPIUM PALMERII, *Watt*, 204–206; description of 164, 319

GOSSYPIUM PERUVIANUM, *Cav.*, 213–226, *also* App. C, p. 382; origin of races and hybrids, 166–7, 219–20, 276, 326; habitat and distribution, 214; description of, 165, 214; vern. and trade names, 45, 214–5, 220–4; affinities to, 217; cultivation in C. and S. America, 217–9; in Egypt, 219–24; in W. Indies, 224–5; in India, 225–6; in Africa, 179, 214; difficulty in separating from *G. vitifolium*, 256, 262, also from *G. microcarpum*, 210–11, 214; of Cavanilles, 213, 214, 261. *See* Peru and Peruvian cotton

GOSSYPIUM PUNCTATUM, *Sch. et Thon.*, 168–82, *also* App. C, p. 382; former name for, 44; origin of, 165; diagnostic characters, 163–4, 169–70; vern. and trade names for, 46, 169,

177; wild forms of, 169, 170, 172–5, 192; cultivation in Africa, 155, 171, 174–181, 324; in America, 171, 181, 324; in Egypt, 181–2; hybrids and crosses of, 166; American form first seen by Rohr, 172; no authentic specimen from Abyssinia, 173; association with Sea Island, 347. Var. jamaica, 120, 170, 171, 182, 184. Var. nigeria, 170. Var. prostrata, *Watt*, 174
GOSSYPIUM PURPURASCENS, *Poir.*, 250–55, *also* App. C, p. 383; confusion in naming of species, 228, 253; habitat and distribution of, 251; vern. and trade names for, 250; description of, 245, 250–1; cultivation in Antilles, 254; in Colombia, 254; in New Guinea, 255; acclimatisation of 247; wild acclimatised forms, 253; separation from *G. taitense*, 253; *versus G. mexicanum*, 254; Porto Rico cotton, 250, 263; in West Indies, 305; employed in hybridisation, 334, 335
GOSSYPIUM ROBINSONI, *F. v. M.*, 67–8; resembles THURBERIA, 68
GOSSYPIUM SCHOTTII, *Watt*, 206–210; description of, 164, 206; association with *G. microcarpum*, 166
GOSSYPIUM STOCKSII, *M. Mast.*, 73–77; description of, 61, 74; seed and wool of, 55, 319; near to *G. Harknessii*, 73; a distinct species and purely wild plant, 75, 76
GOSSYPIUM STURTII, *F. v. M.*, 63–65; bractlets and seeds of, 242, 319
GOSSYPIUM TAITENSE, *Parl.*, 248–250; habitat and distribution of, 249, 250, 325; description of, 244–5, 248; in Polynesian Islands cultivated and wild, 246, 247, 249, 254; probable oldest specimen, 249; naked-seeded wild cotton, 320
GOSSYPIUM TOMENTOSUM, *Nutt.*, 69–70; mistakes made, 70–1; seeds of, 319. Var. paryifolia, 71
GOSSYPIUM VITIFOLIUM, *Lamk.*, 255–65; habitat and distribution of, 246–7, 257, 281; vern. and trade names, 45, 256; description of, 245, 256; opinions of authors, 258–61; races of, 223, 241, 261–5; hybrids of, 325, 334; affinity to *G. microcarpum*, 210; to *G. barbadense* and *G. peruvianum*, 256; claim to being wild, 257, 261, 262–3, 306, 325; frontispiece, 260; and Sea Island confusion by Wight, 261; Roxburgh's mistakes both in drawings and description, 261, 301; of Rohr's account, 262–5; degenerated stocks, 275; one of the ancestors of Sea Island, 286; of Egyptian, 292; of the West Indies, 305; forms of, 306, 334; origin of name for, 325; annual forms, 264, 325; of certain writers, 312, 325
Goza, Afghan name for *G. herbaceum*, 156
'Grayson,' trade name, 238
Great Britain: *see* England
Greece and the Greeks, early mention of cotton in, 10–11, 157–9, 215. *See also* Europe
'Green Crown Cotton,' origin of name, 263
Green-seeded cotton. *See* Floss and Fuzz
'Griffin,' trade name, 239
Guadeloupe cotton, 120, 187, 212, 256, 259, 264, 286. *See* Antilles (French)
Guatemala, cotton of, 59, 158, 228, 242, 268, 298; weevil-resisting in, 242, 310. *See* America, Central
Guayaquil, 218. *See* Peru.
Guaymas, *see* Mexico
Guiana and Guiana cottons, British (Demerara), Dutch (Surinam, *which see*), French (Cayenne), 98, 134, 216, 264, 268, 296, 305, 306, 307; of Rohr, 255; and Brazilian of Rohr, 295, 298–9, 305
Guinea, cotton of, 18, 154, 173, 175, 202; Liberia, 215
Gujarat cotton, 13, 14, 89, 94; in Cambay, 13, 120; annual forms, 139–53; perennial (tree), 13, 14, 134–9; *see also* Tree Cotton; Navsari (red) 82, 93; wild, 140; races of, 149–51; hybrids of, 151–53; oldest specimen, 145–6; *G. purpurascens* in Gujarat, 254; Hove's Lymree and Mitampur plants, 299, 313–14; Hove's Dholca cotton, 144, 151; *G. brasiliense* in, 313. *See* Bombay
Gulf region: *see* Florida
'Gunn,' trade name, 238

Hadicæ or *hadie*, Arab name, 15, 84
Hadramaut: *see* Arabia
Hainan, cotton of, 251
Hamouli, an Egyptian cotton, 221
Harar, East Africa, famous cotton cloth of, 311
Hargreaves, discoveries by, 19
Hariri cotton in Egypt, 221
Harrison, Professor J. B., sugar-cane seedlings, 340
Hastings, Lady, plant (kidney form) grown at Futteghur farm, Calcutta, by, 314
Hawaii and Hawaiian (Sandwich Islands) cotton, 43, 63, 69–71, 72, 216, 275, 294, 299; *see also* Polynesia

'Hawkin's Prolific,' trade name, 193, 238
Hazara, cotton of, 97, 125
Hedges to protect cotton, 131, 290. *See also* Cultivation
Herbaceo, cotton of Branner, 309
'*Herndon*,' trade name, 238
Herzog, Dr. study of cotton fibre, 41
HIBISCEÆ, 53, 346
HIBISCUS CANNABINUS, 52; bracteoles in Hibiscus, 55; *H. esculentus*, 207; *H. Sabdariffa*, 263
Highs, discoveries by, 19
'Hill Cotton,' sent to Roxburgh from Farrackabad, 314
Hilton Head, Sea Island cottons in, 21
'Hindi Weed' of Egypt, 182, 209, 221, 223, 313; origin of name, 182; from Egypt to India, 171; and *moqui* difficult botanical separation of, 182. *See also* Egypt.
Hinganghat silky cotton: *see* Bani, Nagpur and Berar (Oomras), *also* Hybrids and Hybridisation.
Hiraganda-kápas, vern. in India for *Roji*, 136; *Hiraguni kápas*, Indian vern. for *G. Stocksii*, 75
History, Cotton and Cotton Industry, 9–24; records of America, 100
Honolulu: *see* Hawaii
Hont, Abyssinian vern., 159
Hove, Dr., described red and yellow flowered cotton, 94–5; perennial and annual cultivation in Gujarat, 136, 137. *See* App. A
Hulu-hulu, Hawaiian vern., 69, 70
Humidity of cotton spinning. *See under* Fibre
'Hunnicutt,' trade name, 193
Hybrids, Hybridisation and Crossing experiments, 331–51; 2, 58, 59, 62, 81, 88, 89, 90, 113, 133–4, 146, 165, 182, 185, 190, 192, 193, 207–9, 223, 224, 229–30, 241, 247, 270, 278–9, 282, 285, 286, 292, 302, 306, 315, 317, 321, 326–7, 348; origin in specific areas, 208; result of cultivation with, 42, 229; of allied species and different groups, 62; Burn's mosaic hybrid of Broach, 89, 335; from Bangkok, 93; Major T. Clarke's experiments, 111, 113, 134, 165, 190–1, 336–8; Gammie's experiments, 109, 111–12, 134, 332, 339, 346, 348; Aliotta's studies, 274, 331–2; Tracey's experiments, 192–3, 332; Ball's experiments, 194, 234–5, 339; Cannon's investigations, 339–40; Chinese and Indian, 134; Asiatic × American (Old and New World forms), 134, 152–3, 165, 190, 191, 321, 336, 339; crosses between naked and fuzzy seeds; *G. hirsutum* × *barbadense*, 194; special Egyptian hybrids, 223; crossing of Sea Island and fuzzy-seeded, 278; American Upland and Sea Island, 278; between naked and fuzzy, 278, 292, 293, 321, 335–6, 339; crosses between fuzzy seeds only, *G. arboreum* with *G. herbaceum*, 146; *G. obtusifolium* and *G. Nanking*, 147; races of var. *Wightiana*, 151–2; between *G. herbaceum*, *G. hirsutum* and *G. obtusifolium*, 165; of var. *nigeria*, 166, 324; with Hindi Weed, 182; between *G. hirsutum* and *mexicanum*, 185; of *G. mexicanum*, 193; between *G. punctatum* and *peruvianum*, 216; of *G. Nanking*, 323; of var. *jamaica*, 324; crosses between naked seeds only, 134, 246, 247, 334; of *G. barbadense*, 268; hybrids of *G. barbadense* and *G. brasiliense*, 281; of *G. vitifolium*, 281; of Sea Island, 282; between Sea Island and Bourbon (suggested), 337; failure and difficulty in, 190, 337, 340; list of American historic hybrids, 193; remarkable hybrids, 216; experiments in W. Indies, 225; modern stock, 270; hybridisation and racial production, 285, 287, 288; hybridisation and trade requirements, 286; natural and artificial, 332; an important cross, 335; in America, 338; strength of, 338; of the sweet pea contrasted, 340, 349; of sugar-cane, 340; conditions favourable for, 340; systematic, 342; indicated by pollen grains, 346; dominant characters in, 350, 351; complexity in, 350

Ica cotton of Peru, 210
Ichcaxihuitl of Ximenes in Piso, 255
Imbabura cotton of Peru, 214, 218
Improvement of cotton: *see* Stock
India and Indian cottons, 46, 73–7, 81–91, 93, 95–114, 116–7, 124–37, 139–53, 157, 171, 183–4, 198–200, 201–4, 227, 251, 254, 257, 267, 294, 298, 313, 335; in classic times, 9, 11; first definite account of cultivation and trade in, 11–12; perennial in thirteenth and sixteenth centuries, 13, 14, 15; manufacturing cotton goods beginning Christian Era, 12; Calicut in ninth century, 13; improvement of cotton of, (£20,000,000), 20, 22, 23; first cotton mill in, 21; appointment of cotton commissioner, 23; cultivation of New Orleans, attempted in, 22; grade terms, 46–47; date of arrival of cotton in Liverpool, 50; introduction into America of, 81, 124; common cotton in (1809), 65; early writers on, 87; most abundant

cotton in India to-day, 99–100; and American forms of var. *neglecta* inseparable botanically, 102; most inferior cotton of all, 113; wild cotton, *see* Indigenous; cotton soils and areas, 147; acclimatisation of American species in, 198–200; Egyptian cottons engaging attention, 225; early cultivation of *G. mexicanum*, 229; acclimatisation of *G. purpurascens*. 254; Sea Island in, 272, 294; 'Indien Cotton' of Rohr, 254, 334; *G. brasiliense* in, 313–15; Gammie's experiments, *see* Appendix B; cotton approaching the Uplands, 336–7. For further particulars *see* Appendix B under Aitchison, Brandis, Hamilton, Hooker, Hove, Gammie, Griffith, Jameson, McClelland, Rottler, Roxburgh, R. E. P., Wallich, Wight, &c.

Indigenous (wild or ancestral) cotton, 2, 4, 5, 6–8, 10, 33, 86, 87, 167, 191, 208, 340; of Abyssinia, 158; of Africa, 22, 138, 143, 145, 153–4, 169–70, 173, 177, 192, 316; of America, 17–18, 169–72, 182, 192, 204–6, 208, 210, 257, 267, 324; of the Andes, 214; of the Antilles, 257, 262, 267, 333; of Arabia, 74–5, 157; of Brazil (Ceara), 168, 298–9, 304, 308, 326; of California, 66, 73; of Galapagos, 67, 68; of Hawaii, 70, 72, 246, 247, 249; of India, 74, 75, 86, 140, 142–3, 314; of Java, 294; of Mexico, 204–10, 213, 259, 326; of Polynesia, 248; of Yucatan, 207, 213; characteristics and classification of, 7; study of essential, 8; colour of staple, 28; condition of seed (fuzz and floss), 41, 42, 319, 320, *see* Floss; diagnostic peculiarities of, 62; plant, rare, 72; wild, *see* Feral; a wild cotton resembling *Cienfuegosia Gerardi*, 73; wild or long acclimatised. *See* Acclimatisation

Industry and industrial uses of cotton: points of importance, 9, 36, 40, 45–51, 59; spinning and weaving, 10, 11, 29, 38, 45, 103, 105, 106, 107, 176; Sinnergam cotton manufacturing, 14, 95; India a cotton manufacturing country, 12, 13, 17, 18, 19, 24, *see* England; in South Africa, 17; in Mexico, 17; in Brazil, 17, 303–4; merits of Peruvianum cotton, 17, 45, 217–19; factories established and destroyed, 20–1; early opinions regarding Dacca cotton, 103, 105; in W. Africa, 177; separation of *G. barbadense*, 266; suited for higher counts, 49, 234–5, and finer goods, great strength (Sea Island), 284; in Peru, 218, 219, 303 in West Indies, 291; production and demand, 200. *See* Commerce and Commercial Enterprise, Muslin, Quilting, Stocking, &c., Cottons

Insular plant, 249, 251

Inteiro cotton, 308

Irrigation and irrigated cotton in India, 95, 131; in Africa, 178; in Peru, 218; in Egypt, 220; scheme for Sind, 225; for Sea Island, 276; in United States, 288. *See also* Cultivation

'Island Cotton'—a term given to cottons of Polynesia, Antilles, &c., and which led subsequently to the special distinction of Sea Island, 264

Italy, cotton of: *see* Europe

'Jackson's Limbless,' trade name, 232, 238

Jadi or *Judi*—Ind. vern. names: *see under Jari*

Jamaica and Jamaica cottons, 169, 171, 185, 186, 216, 258, 298, 299; Pernambuco seed procured from, 20, 272, 276; wild cotton, early mention of, &c., 169, 170, 172, 191; muslin cotton, 189; Montego Bay, 216; Murray's vine-leaved cotton of, 258; 'Withy Wood,' 263; Sloane's specimens and opinions on same, 300–2

James Island (America), cotton of, 195, 271–3, 277, 282–4, 289. *See* America, *also* Sea Island

'Jannovitch,' an Egyptian cotton, 221, 222, 223, 292; in India, 225. *See* Egypt

Japan and Japan cottons, 46, 83, 98, 102, 116–17, 141, 298; stock compared with Bengal plant, 102, 124; *Aoki*, 118, 123; *Kawasaki*, 123; *Murasaki*, 123

Jari, Indian vern. name for a special hybrid, 96, 97, 98, 108, 112, 132

JATROPHA CURCAS, 168

Java, cottons of, 83, 84, 93, 98, 132, 184, 217, 228, 258, 268; *G. vitifolium* in, 258; Sea Island in, 294. *See* App. A, *under* Zollinger

Jhum, an Indian term for burning weeds, 110

Jethi, 131–2

Jowari-hatti, Indian hybrid race, 149, 152–3, 339

Judi: *see Jari*

'Jumbo,' trade name, 238

Jumel cotton, 166, 219, 220, 223, 313; stock, *G. brasiliense*, 224; 'Jumel Cotton,' doubtful specimens, 258. *See* Egypt

Junagadh: *see* Kathiawar

Jute, 52

Kabul: *see* Afghanistan
Kach, cotton of, 145
Kadayo of Bhavnagar: *see* Kathiawar
Kahnami cotton (*G. obtusifolium, var. Wightiana*), areas and *Kahnam* soils, 137, 146, 148–52
Kala-kala, vern. name in Java, *which see*
Kanbi or *kanvi*, Ind. vern. name, original stock of, 148, 151–2
Kanmiri, 152
Kanpuri: see Khanpuri
Kapas (the most general Ind. vern. name for cotton), 95; *kapas banda*, said to be Javanese name, 294. *See also Capas and Gapas*
Kapok, 10
Karachi: *see* Sind
Karkatown: *see* Liberia
Kárpási, classic Sansk. name for cotton, 9, 10, 12; *karbasus*, 11; *carbasus*, 10; *karpason, karpasos*, 9, 10, 59
Kashgar, production and manufacture of cotton in, 13
Kashmir, cotton of, 125, 126, 288. *See* Panjab
Kátan or *kutan: see* Qutn
Katel or *kateli*, 96–7, 98; *katel belati* cotton, 112
Kathiawar, wild and cultivated cottons, 98, 140, 143–52, 172; **Bhavnagar**, 183; **Girnar**, 150; **Gondal**, 152; **Junagadh**, 129, 140; **Morvi**, 152; **Palitana**, 150; **Verawal**, 152; **Wankaner**, 152; **Dhollera** (a collective name for Kathiawar cottons), 151. *See* Bombay, *also* Gujarat
Kawasaki: see Japan
Kay, discoveries by, 19
Keasa, Kashmir vern. name, 172
Kekchi, or Guatemala cotton, 228, 241–2
Kelbe, tree cotton of, 13
Kelep, protection afforded by, 241–2
Key West: *see* Florida
Kempy, or dead cotton: *see* Fibre
Khaki (red or brown) cotton: *see* Floss
Khandesh cotton: *see* Deccan, *also* Bombay
Khanpuri, Ind. vern. name for a recently introduced cotton, 150–1, 152
Khartoum: *see* Soudan
Kherdya, Ind. vern. name, 97
Kheri: *see* Agra and Oudh
Khorasan cotton, 156, 158
Khotan, production and manufacture of cotton in, 13
Khungi deva, Ind. vern. name, 108
Kidney (or chain) cotton, 18, 44, 161, 295–315, 325; **confusion** in naming of, 204, 215, 300–1, 310; description of, 297; first brought from **Brazil** and grown in Europe, 300; value of early records of, 302; seeds early figured, 306; **unpopular staple** of, 306; lost popularity of, 308; **yield** of, 308, 315. *See also G. brasiliense*
Kil (Nagpur), 108, 110–11, 112. *See* Assam, also Garo Hill Cotton
'King's Improved,' origin of, &c., 169, 207, 209, 238; highly cultivated state of *var. jamaica*, 182
Kinkiang: *see* China
Kokio cotton: *see* Hawaii
Kongone: *see* Zambesi
Konkho chicao, Ind. vern. name, 112
Kookee cotton, 98
Kordofan: *see* Soudan
Korea, cotton of, 123, 125
Kota-kota of Nyassaland, 171
Kouku of Central Africa, 171
Ktesias, 10, 12
Kumpta (S. Maratha), a race of Indian cottons: Comptah or Coompta, trade name, 46; early maturity, 140, 148, 151, 199
Kurdistan, cotton conveyed to, 16
Kurnool: *see* Madras
Kutun: see Qutn
Kwebe Hills: *see* Ngamiland
Kyan, Jean, successful cultivation in Sainte-Croix, 305
KYDIA, 53

Labuan (Borneo), cotton of, 298
Laccadive, cotton of, 252
Lado, vern. in Senegal, 177
Lagos and Lagos cottons, 46, 176, 180, 298; **Abbeokuta**, 92, 215; **Badagry**, 171
'La Guayran,' trade name, 46
Laguna: *see* Mexico
LAGUNARIA, 53
Lalio or *lahrio*, Ind. vern. names, 49, 132; description of, 150–1; becomes almost *Roji*, 152
Lamu and Witu: *see* E. Africa
Lancashire atmosphere, effect on yarn, 37
Late maturity cottons: *see* Cultivation
'Layton's Improved,' trade name, 234
Leavet (1785), early **Sea Island** cultivation in the Islands of Georgia, 20
Lecard, M. Th., experiments (1865) in cotton cultivation in **W. Africa**, 178
'Lee,' trade name, 238
Levant and Levantine or **Turkey Cotton**, 17, 18, 20, 21, 46, 81, 155–63, 264, 272. *See* Europe, Malta, Asia Minor, &c., *also under G. herbaceum*
'Lewis Prize,' trade name, 234
Liberia (Karkatown): *see* Guinea
Lima: *see* Peru
LINEÆ, 52
Linon (flax), 10, 12

'Lint,' a popular name for clean cotton. *See* under Floss
'Linters,' trade name, 45
LINUM USITATISSIMUM, 52
Listados, cotton used for, 320
Liverpool, dates of arrival of cottons in, 50; Liverpool and Manchester Cotton Brokers' Association, 49. *See* Forester, App. A
Livingstone, Dr., cotton cultivation in Africa, 23. *See* under Kirk in App. A
'Loaf Cotton,' 263
Long-bolled cotton of Rohr, 109
Lotti and Lakor: *see* Malaya
Louisiana, wild cotton of, 17; introduction of, into Siam in 1758, 19, 81, 120; or New Orleans cotton, 195
'Low Middling' = L.M., 47
'Lowry,' trade name, 238
Luabo River: *see* Zambesi
Lucas, Miss, plantation in South Carolina (1739), 19
Lush, C. (1839), Pernambuco cotton in India, 314
Lymree: *see* Gujarat
Lynhurst: *see* Australia

Macao: *see* China
Macassar, cotton of, 83, 93
'Maceio,' trade name for a Brazilian cotton, 45
Madagascar and Madagascar cottons, 116, 122, 131, 135, 141, 216, 228, 247, 249, 251, 257, 258, 298
Madeira, cotton of, 171
Madras and Madras cottons, 145, 151, 216, 228, 252, 258; Calicut, 13; inferior stocks of (Nadam), 128–31; superior stocks of (Uppam), 151; Coimbatore, 93, 112, 185, 252; Coconada, 46, 128; Kurnool, 144; Palaveram, 126; Tranquebar, 96, 101, 252; Tinnevelly, 46, 129, 149; acclimatised Bourbon, 251; trade names 'Tinnevelly,' 'Coconada,' 'Madras,' or 'Westerns,' 46. *See also* Mysore and Coorg, Nilghiri Hills, &c.
Magdalena Bay, cotton of, 66
Maibung Salu: *see* Philippine
Mako, cotton in Egypt, 312
Malabar, cotton of, 13, 14, 98
Malaya and Polynesia, cottons of, 83, 116, 140, 141, 211, 247, 249, 275, 294, 298–9, 311. *See* Celebes, Labuan, Philippine, &c.
Malindi: *see* East Africa
Malta, cotton of, 156–7, 159, 309
MALVA, MALVEÆ and MALVACEÆ, definition of, &c., 52–3, 59, 340, 346, 348–9; Malvastrum and Malvaviscus, 53
'Manchester Cottons,' historic incidents in trade of,' 12, 17, 19, 37
Maniim cotton, 296
Mangrol: *see* Gujarat
Manipur: *see* Assam
Mantas, cotton used in weaving, 320
Manoulou-akecha, 259
Manua, Ind. vern. for tree cotton, 82, 95
Manufactures: *see* under Industry, Fibre, Muslin, Stocking, &c. Cottons
Manyú of Varnhagen, 296
Mao cotton, 69, 70
Map shown to Cortez, 302
Maragan cotton, 256, 261; 'Maragnan' of Poiret, 264; 'Maranhams,' 45; *Maranhao*, 308, 309. *See* Brazil
Maratha Country: *see* under Deccan
Margarini, E. Africa, 312
Martinique, cottons of, 244, 268, 299. *See* Antilles, *also* 'Rabinal' and West Indies
Mascarene Islands, cotton of, 247, 251; Rodriguez, 249, 298
Masulia, famed for its calicos, 12; Masulipatam, fine buckrams of, 14
'Matthews,' trade name, 239
Mathi, *mathio*, Ind. vern. names, 96, 131, 132, 150
Maturity: *see* Cultivation
Mauritius, cotton of, 172, 252
Meares, Dr., 276
Mediterranean regions, cotton of, 157; ancient cotton of, 16
Meerut: *see* Agra and Oudh
Mehemet, Ali (Khedive of Egypt), encouraged cultivation of cotton, 312
'Memphis,' trade name, 45
'Menouffieh,' trade name, 45
Mercer, John (1850), 38; mercerising. *See* Fibre, *also* Rawson, &c., in App. B.
Mesopotamia, cotton of, 157; probably indigenous, and cultivated there, by the Saracens, 16. *See* Asia Minor
Mexico and Mexican cotton, 181; discovery of, 17, 18; introduced into the Mississippi, 21; trade names, 46; wild, 73, 170, 192, 205, 242, 259; Carmen Island, 73; Coahuila (Laguna desert cotton), 170; Guaymas cottons, 66, 268; Mexican influence on cultivated stocks, 193, 305–6; rough and red Peruvian, 210–11; Uplands, 226–39, 242, 326–7; manufactures of: *see* under Industry. *See also* Uplands, Georgia and *G. mexicanum*
'Middling,' Md., 'Middling American' the standard, 47, 51; 'Middling Fair,' M.F., 47
'Mikur Hills' cotton, 129. *See* Assam
Mill, first Indian cotton, built, 21
Mineral constituents of cotton: *see* Chemistry under Fibre

Mipe, cotton of, 154
Mit afifi, Egyptian vern. name for special race of, 220–1, 224; 45, 166, 182, 198, 214–5, 223, 293; cotton of to-day, 185; botanical description of, 224; in India, 225. *See also under G. peruvianum*
Mitampur: *see* Gujarat
'Mobile,' trade name, 45
Moçambique, cultivation of cotton in, 197–8, 293
Mokho, West African vern. name, 177–8
Moisture and humidity: *see under* Fibre
Mogul Country, seed from, in 1621, 100
Molango cotton, met with in India, 172; origin of, 182; botanical comparison with *moqui*, 182; 'Molango,' description of, 231; bractlets seen in, 242. *See under G. mexicanum*
Molokai, wild cotton of Sandwich Islands: *see* Hawaii
Mombassa (N.): *see* E. Africa
Montego Bay: *see* Jamaica
Montpelier: *see* France
'Moon,' trade name, 239
Moqui of Arizona, 181; comparison of Egyptian and Arizona forms, 181; used in crossing Sea Island,' 292
Moradabad: *see* Agra and Oudh
'Morris' cotton, trade name, 238
Mosaic hybrid: *see* Hybrids
Moss, Mr., 276
Moto mathio: Ind. vern. name, 131
Mowee: *see* Hawaii
Mummy cloth, controversy regarding, 25
Murasaki: see Japan
Muslin and muslin cottons, manufacture of, in England, 20; far-famed Dacca, 12, 102–7; East Gujarat, 136; Masulipatam, 12; 'Muselin' cottons of Rohr, 183; best form of 'Muselin,' 189; four kinds, 189. *See* Industry
Mutations and Variations: *see* App. B *under* De Vries
Muxinha cotton of Angola, 311
'Myers,' trade name, 238
Mysore and Coorg, cottons of, 126, 149

Nadam (or *yerra*) cotton, 128–31, 132, 137; *yerrapatti* or *errapathi chettu*, names for special races of, 130; compared with *Bani*, 131–2, *See* Madras Cottons
Nagasaki: *see* Japan
Nagpur and Berar cottons, 46, 109, 111, 113, 124, 131–34, 336–7; Saugor, 98. *See also Bani*, Hinganghat, Hybrids and Hybridisation, Oomras, &c.
'Naked Cotton' of the French, 262
Names, priority and uniformity in, 2, 5, 300–1; misleading, 4; reckless naming, 5; earliest retained for each species, 6; enigma of, 7; classic, 10; confusion of, 12; naming of races and hybrids, 230
'Nankeen' (Nankin) or brown-coloured (khaki), a term assigned to cottons of several species. *See under* China, *also* Floss
Naples cotton: *see* Europe
Natal: *see* S. Africa
Navsari cotton: *see* Gujarat
N'Dargua cotton, description and geographical position of, 177; cultivated state of, 178; presumably *G. punctatum*, 178; of Senegal a probable ancestor of 'Hindi Weed,' 182
Nectaries: *see* Glands
Negro Country, cotton of, 173, 210; value and trade in, 175; of Senegal, 212–13; slave trade influence on cotton, 18, 311
Neocosmospora vasinfecta, 330
New Caledonia, cottons of, 249, 251, 252
New Granada. *See* Columbia
New Guinea (German), 255
New Orleans and New Orleans cotton, 45, 183, 198–9, 241, 251, 253, 277. *See* Dharwar (*G. hirsutum*), *also* Uplands and Georgian
New World cotton and cotton goods, 60, 209; cotton carried to, in seventeenth century, 81; first illustration of, 259. *See also* Old World
New York Cotton Exchange, 49
Ngamiland (Kwebe hills), cotton of, 153
N'Guine cotton, description of, 177–8; probably *G. purpurascens*, 178
Nicaragua, cotton of, 228
Nicobar Islands, cotton of, 144
Niger and Nigeria, cotton of, 92, 154, 161, 169, 170, 171, 179–180, 215, 228
Nilghiri Hills, cotton of, 126, 252
Nimari cotton, 112
Noel, Sir Martin, dispute with East India Company, 12
'Norfolks,' trade name, 45
Nubische Kuste, cotton of, 251
Nun's cotton, 101, 120, 144, 189, 201
Nurdki cotton, 112
Nurma (*narma* and *nurmah*) cotton, 82, 91, 92, 95, 98, 105; hybrids, 336–7
Nyam Nyam cotton, 223; of Mr. Broun, 298, 312
Nyassaland: *see* East Africa

Oahu cotton: *see* Hawaii
'Oak,' trade name, 238

Obrajes (or factories) forbidden in Peru, 219: *see* Industry
Ochro (*Hibiscus esculentus*), 207
Odjas, Arab name for cotton, 15
Oil (cotton): *see* Seed
Okra cotton, 81, 100, 207–9; origin of, 100–1; 'Okra or Split-leaf,' trade name, &c., 233–4
'Old Bess,' cotton of Rohr, 263
Old and New World forms. 2, 244, 267; cultivated cottons, 87; wild, 4; *G. herbaccum*, 163; hirsute plant, 186; crossing of, 336, 338–9. *See also* New World
Oliver, E. L.; remarks on wages paid for cotton manufacture labour, 292
Omboland, cotton of, 153
Oomras (*Umras*, 'Oomrawuttee' or Amraoti cotton) and Hinganghats: *see Bani*, *also* Nagpur
Oriental species, 139–155
'Orleans,' trade name: *see* New Orleans
Otaheite: *see* Tahiti
Oth, Arab name for cotton, 15
Oudh: *see* Agra
Ou-ti, Emperor of China in sixth century robed in cotton, 13
Owhyhee: *see* Hawaii
Owu, Abbeokuta vern. name for cotton, 214, 215
Ozier Silk, a trade name, 241

Pabna cotton: *see* Bengal
'Pachon,' cotton of Guatemala, 244
Page, Captain, 309
Paidi, 296; *paira* (Tamil vern.) cotton, 128, 130
Pakhoi (S. China) wild cotton; *see* China
Palaveram: *see* Madras
Palestine (Bazac), cotton of, 160
Palmerston, Lord, prophecy regarding cotton in Africa, 23, 174
Pamidi patti, Tamil name for cotton, 296
Panjab, cottons of, 84, 93, 96, 97–8, 125, 131. *See* Kashmir, India, &c.
Paraguay, cotton of, 207, 268, 298: *see* America, South
'Paraiba,' trade name, 45
Paretty, vernacular name, *see* Cuda pariti
'Parker cotton,' trade name, 233
PAVONIA, 53
'Pedigree Canes,' 341
'Peeler,' trade name, 45, 235
Peel, Sir Robert, introduced 'resist' printing, 21
Pekin: *see* China
Perennial cottons, 74, 77, 82, 84, 115, 124, 128, 134, 136–7, 168, 214, 255, 264, 266, 278, 309; early mention of in the East, 10–11, 12–14, 15, 129, 135–7; state of Sea Island changed to annual, 278. Compare with Annual, *also* Tree and Shrub Cottons
Pernambuco (Fernambuco) cotton (*G. brasiliense*, also *G. peruvianum*), 295–315; 214, 267, 271, 272, 287, 296, 301, 302–3; grown near Georgia in 1789, 20, 276, 287; of Kirk, 311; climate of, 310. *See* Brazil, *also* 'Peruvian' Cotton
'Pernams,' trade name, 45
Persia and Persian cottons (*G. micranthum, Cav.*), 116, 120, 122, 125, 157, 158, 184; seen by Marco Polo, 13; conveyed to by the Saracens, 16; 'Persian Tree Cotton,' 185
'Peterkin,' trade name, 241; Peterkin's Limb Cluster,' trade name, 238. *See also* under Staple
'Petit Gulf,' trade name, 238
Peru and Peruvian cotton (*G. peruvianum*), 213–26; in 1522, 17; trade names, *e.g.* rough, smooth, and red, 45, 210–13; Chanduy cotton, 215–16; description of by Spruce, 218; Spanish influence on, 219, 303; maladies and pests of, 219; Piura the chief indigenous cotton of, 256; Azara's account of Lower Peru, 305. *See* Egyptian; *also* Pernambuco
PHASEOLUS ACONITIFOLIUS, 96
Philippine Islands, 98, 140, 141, 174, 211, 249; *see also* Malay
Phœnicians and Hebrews, cotton known to the, 9
Phootee, Indian vern., 105
Picu (Sanskrit name), 9
PISUM SATIVUM, 341, 350
Piura or Amazon cotton; *see* Peru
Pizarro (1522), found cotton in Peru, 17
Planters, points of special interest to: *see* Cultivation
'Politie of Keeping the Sea,' 16
Pollen-grains (Plates Nos. 52 and 53); 343–351, 62, 287, 315; of *G. Sturtii*, 64, 345; of *G. Darwinii*, 68, 345; of *G. Davidsonii*, 69; of *G. Drynarioides*, 72, 345; of *G. Stocksii*, 75, 345; experiments—the Broach hybrid, 89; of *Roji*, 137, 345; studies of, 287; of American fuzzy-seeded cottons, 320; of Asiatic fuzzy-seeded cottons, 320; of *G. Nanking*, 323, 345–6; when to apply the, 338; of hybrids, 339, 346; similarity of, in Gossypium and tribes of Malvaceæ, 340; a help in hybridisation, 342–3; micro-photographs of, 343; structure and description of spore, 344; chief types of, 344; tubes of, 344; of *G. punctatum*, 344; hyaline spines of, 345; of *G. arboreum*, 345; of *G. barbadense*, 345, 349; of

G. brasiliense, 345–6; buttressed condition of, 345; of *Cienfuegosia*, 345; of *G. hirsutum*, 345, 346; of *G. Kirkii*, 345; of *G. obtusifolium*, 345–6; of *G. Palmerii*, 345; of *G. peruvianum*, 345–6; opaque trapezoid wart condition of, 345; palisade condition of, 345; in Uplands, 345, 346; of *Pavonia*, 345; of *Thurberia*, 345; different in same anther, 346; in Gammie's Poona hybrid, 346; in Gossypia not generic, 346; of Hibisceæ, 346; of Malveæ and Malva, 346, 348, 349, 350; of Ureneæ, 346; Slater's opinion regarding absence of detached spines, 345; spores of *Goghari* × *Varadi*, 346; an aid in separating species, 347; further investigation recommended, 347; of Schacht's *G. religiosum*, 348; W. Smith's opinion of, 349; of the sweet pea, 349; of the rowan, 350; of the tamarisk, 350; of the black currant, 350. *See* App. B under Crépin, Edgeworth, Lindau, Sachs, Schacht, Strasburger, and Ward
Pollination: *see* Hybridisation
'Pollards Rose Cotton,' from Barbados, 299
'Pollock,' trade name, 193
Polynesian wild cotton, 247–8, 244, 249, 251, 255; Tonga Islands, 228, 298; Savage Island, 298. *See also* Fiji, Hawaii, Malay, Tahiti, &c.
Porto Rico, cotton of, 210, 211, 213, 250, 251–2, 253, 254, 263, 268, 299, 335. *See* West Indies (Spanish)
Prices of cotton; *see* Fibre
'Procumbent Cotton of Guiana,' 241
Production: *see* Cultivation
Prolific Medium Boll Series: *see* Staple
Providence Island, Cotton of, 300
Pruned: *see* Ratooned Cotton
Pulling cotton: *see* Fibre
Purry, Peter: *see* Carolina

Quebradinho cotton: *see* Brazil
Quilting and upholstery cottons, 10, 17, 303
Qutn or *katan*, 10, 12, 59

Rabbit-tail cotton, 299
Rabinal cotton, 244. *See* Martinique
Racemose cotton, origin of, 253; cf. with Porto Rico under West Indies
Races: *see* Hybrids; racial tendencies, 87
Radya, 95
Rajputana and Central India, cotton of, 298, 314
Ram-kapas, Indian vern. names for tree cotton, 82, 202
Rangoon: *see* Burma
Rasteiro (dwarf) cotton of Brazil, 241, 309
Ratooned and pruned cottons, 94, 259, 286, 309, 322
Recessive forms and reversion, 2, 28, 33, 88, 102, 111, 121, 194, 208–9, 230, 234, 246, 326, 332, 341, 350–1; 'Hindi Weed,' a hybrid of **Moqui**, 182; splitting forms, 153; 'natural' and 'seminal' sports, 233, 341
Records, value of early, 302
'Red,' trade name, 45
Rekkam, vern. syn. for *Uppam*, *which see*
Religious cotton of Hindus: *see* Sacred Cotton
Rendle, Dr. A. B., 260
Reporter on Economic Products: *see* App. A, under R. E. P.
Reversion: *see* Recessive Forms
Rimo, West African vern. name, 177
Ring, Indian garments drawn through, 13
Rinon: *see* Kidney Cotton
Rio Grande cotton of Peterkin type, 45, 238
Rio de Janeiro: *see* Brazil
Riqueza cotton in Brazil, 183, 296, 309, *See G. hirsutum*
Robertson, correspondent of Roxburgh (1800), 314
Rodriguez: *see* Mascarene
Roji cotton, 134–7, 84, 123, 125, 132, 138, 152; early allusion to in India, 11; of Gujarat, 130, 135–6; hybridising of, 137; degeneration of, 137; cultivation of, 137
Roman cotton, 201: *see G. hirsutum*, *var. religiosa*
'*Ronoaks*,' trade name, 45
'Rough' and Red Peruvian: *see* Floss
Rudolf, Lake: *see* East Africa, British.
'Rum and Sugar Cotton,' of Martinique, 263
Rusby, Prof. H. H. (1894), 192. *See also* App. A under Britton & Rusby
'Russell,' trade name, &c., 236, 238
Russia (Asiatic), three distinct cottons grown in, 239–40; introduction of American cottons into, 239, 240, 241; increased production in, 240

Sacred or religious cotton of India, 41, 201–4, 320
Sadhus (Hindu religious mendicants), 202
Saharanpur: *see* Agra
Sainte-Croix (Danish Antilles), cotton of, 109, 120, 189; cottons in 1787 of,

144, 263. *See also* App. B under Rohr
Salmali: *see* Semul
Samudranta, Sanskrit name for cotton, 9
San Domingo: *see* West Indies
Sandwich Islands: *see* Hawaii
Sange: *see* Angola
Sanskrit names for cotton, 9–10
'Santos,' grade name, 45
Sardinia (Cagliari), cotton of, 186. *See* Europe
Savage Islands: *see* Polynesia
Schimmelmann, M. le Comte, Sainte-Croix in 1789, 120
Schweitzer, recommended use of cuprammonia, 39
'Scinde' (Sind), grade name, 46
'Seroggins,' trade name, 238
'Sea Breeze Cotton': *see Uppam-parthi*
Seabrook, F. P., improvement of Sea Island in James Island, 282
Sea Island cotton, 275–95; in Africa, 293; in America, 277–80, 286, 288–90; in Egypt, 166, 222, 225, 292–3; in Fiji, Hawaii, and Queensland, &c., 294–5; in India, 294; in West Indies, 239, 278, 285, 290–2; early mention and history of, 20, 21, 22, 266, 269–70, 271–4, 276–80, 278–9, 306, 325; small demand for, 22; length of staple, 35, 284; breaking point of, 40; condition of seed in, 44, 279; grades and quality terms of, 45, 47–49, 279; origin of name 'Sea Island' and plant, 195, 247, 256, 272; separation from *G. vitifolium*, 262, 325; of Spruce and Royle, 265; a modern stock, 270; area of greatest success and distribution of, 275–6, 278, 287; degeneration of, 275, 285; acclimatisation of, 275–80, 310; 'What is Sea Island Cotton'? and answer, 277; markets for, 279; price of, 279, 291–2; practical experiments with, 280; varieties and races of, 278–9, 281–2, 288; improvement of, 282–4; proportion of lint to seed, 283; yield per acre, 283, 290; of Mr. Rivers, 284; effect of high winds on, 284; selection of, 284–5; hybridisation of, 285–8, 315, 334, 347; temperature and rainfall for, 288; favourable soils for, 288; season of planting, picking, sowing, and reaping of, 289–90; Sea Island country proper, 310; 'Sensation Sea Island Cotton,' 331; two pollen grains in, 346. *See also* the note under Island Cotton.
Seed: Naked-seeded, two groups:—(*a*) with bracteoles free and glands conspicuous, 244; and (*b*) with bracteoles free and glands absent, 316; characteristics of (*a*) group, 244–9; wild, 246; floss separates readily, 246; an African form of black-seeded, 246; centres and distribution of, 246, 319; influence of, in production of Sea Island, 247; little known prior to seventeenth century, 247; derived from Antilles, 247, 324; associated with glabrous foliage, 247, 324; fuzzy seeds and hairy foliage, 217; Fuzzy-seeded American and Asiatic, areas of, 80, 163–7, 206, 319, 333; two groups of, America and Asia-Africa, 44, 80, 217, 245, 319; (*a*) with united bracteoles (Asia-Africa), 77–81; and (*b*) with free bracteoles, 163–7 (America); varying into naked, 152–3, 174, 206; Peruvian cotton, 214, 325; Green-seeded: 'The very excellent American cotton with green seeds,' 19, 183, 186–8 (carried to Georgia), 192, 194, 323; Black-seeded, 324–5; Kidneyed (in a 'lump or bunch'), seeds adhering together, 73, 211, 296–8, 306, 308, *see also* under 'Kidney;' Oil-yielding, 52, 271; seed-preservation in oil, 105; seed-farms strongly recommended for India, 175, 329; influence of Mexican supplies on stock of U.S., 193–6; seed easily broken, 254; Rohr's tour to collect seed, 262; seed protection against weevil, 319; for details of conditions of the seed-coats, *e.g.* fuzzy, naked, black, white, green, red (*khaki*), &c., &c., *see under* Floss and Fuzz
Selborne, Lord, passage in despatch on cotton prices, 198
Selection: *see* Stock
Semparuthi (red-flowered) cotton, 93
Semul (and Sansk. *Salmali*) *Bombax malabaricum*, 10; a red-flowered cotton named after, 95
Senaar tree cotton: *see* Tree Cotton
Senegal and Senegambia, cottons of, 154, 169, 171, 173, 175–8, 182, 212, 258, 259; St. Ludovic, 154, 171
Serampore: *see* Bengal
Sessa (Arab name for cotton), 15, 86
Shanghai: *see* China
'Shine,' trade name, 234
Ship's cotton (transl. Burmese name), 296, 315
Shrub cotton, 13, 15, 62, 68, 88, 254. *See* Perennial, *also* Tree Cotton
Siam and Siam cottons, 81, 114, 120, 190, 201, 250, 296, 301; Cambodia, 258, 298
Sibganj: *see* Bengal
Sibpur: *see* Bengal
Sicily, cotton introduced by Saracens to, 15
SIDA, 52, 53
Sierra Leone, cultivation of cotton in,

23, 171, 173, 175–81, 215. *See* Africa, West
Sikkim: *see* Bengal
Silva, P. de, 308
'Simms,' trade name, 235
Sind (Karachi) cottons of, wild, 74–76; tree cotton in, 136; *versus* United States cotton-growing, 225; success of experiments with *abassi* in, 225; species best suited to, 226
Sinnergan: *see* Industry
Sittam: *see* Ashanti
Slater, Samuel, introduced into the States certain English patents, 20
Slave trade, influence on cotton of: *see* Negro Country
Smith, Sir James, correcting Linnean specimens, 203
'Smooth' (trade name), 45
Smyrna: exports in cotton wool, 17; cotton of, 46. *See* Asia Minor
Socotra, production and manufacture in, 14, 211, 216
Soils, adaptation to, 42, 130; inferior, 90; 'black cotton,' 115, 147; red sandy, 130, 288; best dry, 131; clay, 133; *goradu* of Baroda, 148; for *G. arboreum*, 147; for *G. obtusifolium*, 147; for *G. Nanking*, 147; variation in, 147–8; of India, three main classes, 147; for *G. hirsutum*, 195; conditions in Egypt, 221; for *G. peruvianum*, 276; quality and production on various, 288; for Sea Island, 288; soil conditions and proportionate yield, 288; soil improvement, 288
Somali Coast, cotton of, 215. *See also* East Africa
Soonergong, cotton of, 14
Sorrel-like cottons, green and red, 263
Soru kapal, 108
South America: *see* America, South
South India: *see* India
Soudan (Sudan) cottons: *G. soudanensis, Watt*, 138; Khartoum, 135, 138, 215; Kordofan, 154, 185, 251; Bahr-el-Ghazal, 211, 228; White Nile, 154, 251, 258. *See* Tree Cotton
South Africa cottons: Cape of Good Hope, 127; Barberton, 153; Boshveld, 153; Delagoa Bay, 153; Natal, 215
Southampton, Earl of (1621), speaks of cotton seed sent from India to Virginia, 100
Spain, cottons of, 215; conveyed to in tenth century, 15; Spanish flax, 9. *See* Europe
Spermatogenesis, 339
Spinning and weaving: *see* Industry
Split-leaved cotton: *see Okra*
Sports: *see* Recessive Forms
Staple, Long: Indian cotton, 97, 140; Egyptian forms, 182, 222–3, 256, 266, 280, 292; 'Long Staple Uplands,' 194–5, 234–6, 239, 274; geographical distribution of, 235; Long Limb Upland of the Petit Gulf type, 238; of the United States (Sea Island type), 266, (annual), 286; studies of, 280; Cluster Series, 281–2; Sea Island hybridising with Uplands, 282, 339; demand for Long Staple, 285; from East Africa, 293. *See also* Uplands. Short: Indian, 97; of Dacca, 102–7, 133; American short staple of commerce, 158, 169, 183, 185, 195; Uplands of United States, 192–6; 230–41; recent success with, 230; Mexican type, 231; Cluster Series, 231–2; semi-cluster, 232; early small boll, 233; Peterkin, 234; prolific medium boll, 234; big boll, 236–7; storm proof, 237. *See also* Uplands
St. Domingo, Cotton of, 256, 304
STERCULIACEÆ, 52
'Stickland,' trade name, 238
St. Kitts: *see* West Indies
St. Louis: *see* America (U.S.): 'St. Louis,' trade name, 45
St. Lucia: *see* West Indies
St. Ludovic: *see* Senegal
Stocking cotton, 120, 304; *see also* Industry
Stock, improvement of, 319–51; 2–5, 43, 59–60, 123, 147, 154, 229; three methods of, viz. (*a*) selection, 30, 59–60, 90–1, 284, 327–31; first principles of, 342; (*b*) hybridisation, 110–121, 331–51, *see also* Hybrids; (*c*) acclimatisation, 109, 247, 280, 315, 327–8; in America by importation of Mexican seed, 230, 262; in America with Sea Island, 282–5; in the Antilles, 262–4; in China and Japan, 114–24, 133; in Egypt, 219–24; in India, 133–4: in India discouraged, 200; in India for hybridisation, 315; in Jamaica, 301–2; Mexican used to improve *G. hirsutum* and *herbaceum*, 192, 209, 273–4; original stock from Surinam, 287; in West Indies, 335: method of preservation of, 35, 282–3, 328; in indigenous races, 155, 175, 199, 295; by seed farms, 175, 329; recommended by Rohr, 255: successful production of, 273; immunity to wilt, 283; resistant stocks, 284, 331; helps to improvement of, 302; environment and improvement of, 328; a condition of, 329; sudden manifestations, 330; formation of new, 330; natural or accidental, 333; neglect of local, 337; ancient reappearing forms,

342; early stock, *see* Early, *also* Late Maturity Plants; of fibre (mercerising), *see* Fibre; importance of naked seeded, *see* Seed; wild (ancestral types *versus* cultivated), *see* Indigenous. *See also* Sea Island, Uplands, &c.
Stone cotton: *see* Kidney
'Storm Proof,' trade name, 241. *See* Staple
St. Thomas: *see* West Indies
St. Vincent: *see* Antilles
Suakim: *see* Egypt
Sugar plant, displaced cotton in West Indies (1780), 335; industry (1657), 187; recent results in hybridisation of, 341
'Sunflower,' trade name for a long staple Upland cotton. *See* Plate No. 42, p. 236
Sunerwara, India, cotton of, 95
Superstition regarding cotton, 311
Surat, cotton of, 14, 46, 89, 140, 144, 150; finest grade of, 148. *See* Bombay, *also* Gujarat
Surinam (Guiana, Dutch) cottons, 256–65; 20–1, 271, 272–3, 287, 299; plant a possible new species, 256; Linnean specimen from, 301; compared with Brazilian, 306; experiments in India with, 312
Switzerland, cotton of, 159
Synonyms: *see* App. C
Synspermia of Todaro, 253, 262
Syrian cotton, 15, 86, 156, 157, 158. *See* Asia Minor

Tahiti (Society Islands), cotton of, 45, 249, 252, 268. *See also* Polynesia
Tanganika: *see* East (Central) Africa
Teasdale, John and Isaac & Co., 20
Tech, Amazonas vern. name, 296
Telingana, cotton in, 13
Tellapatti, syn. for *Uppam, which see*
Teneriffe: *see* Canaries
'Tennessee,' trade name, 45
Tette: *see* Zambesi
Texas and Texas cotton, 45; wild cotton of, 17; varieties of Uplands in, 238, 241, 243
Themban-wa of Burkill, 296, 315
THESPESIA, 43, 53, 54, 55, 63, 73; *T. Danis*, 72
'Thrush,' trade name, 238
THURBERIA, 53, 54, 56, 63, 345; cotton closely allied to, 63
Tidki, 132
Tiffinia, 132
TILIACEÆ, 52
Tinnevelly: *see* Madras
Tipki, 96, 98, 99
'Toale,' trade name, 234
'Todd,' trade name, 236
Togo-land, cotton of, 215; cotton cultivation in, 180; Sea Island in, 293. *See* Africa, West (German)
Tonga Islands: *see* Polynesia
Tonje kaja (or cadja), African vern. name, 135, 154; *tonje manga*, 183, 185, 196
Trade: *see* Commerce, also Industry
Tranquebar: *see* Madras
Trancaucasian cotton, 118, 123–4, 125; Aschabad, 185
Tree cottons, 12–14, 71–2, 85, 86, 91, 100, 107, 114, 297, 311, 315; of Tylos, 10–1, 60; of India and Africa, 13–14, 82, 87; of Hawaii, 72; of Senaar, 112–13, 114, 138; of Marco Polo, 13–14, 135–6; of Sind, 136; of Soudan, 138, 312; of Egypt (Jumel's), 166; of Jamaica, 185, 216; of Brazil (Zanoni's picture), 300. *See also* Perennial Cottons and cf. with Shrub Cottons
Trinidad: *see* West Indies
'Triumph,' trade name, 237
'Truitt,' trade name, 238
Tula, a Sanskrit name, 9, 10
Tundikeri, a Sanskrit name, 9
Turkey, cotton conveyed to probably by Saracens, 16; 'Turkey kind,' 19. *See also* Asia Minor
Tût cotton, 311
Tylos: *see* Tree Cottons
'Tyler,' trade name, 238

Uganda, wild cotton of, 311
Ukkam: see Uppam
Ukoko, cotton of the Congo, 214, 215
United Provinces of India: *see* Agra
Upland cottons, 186–8, 192–6, 231–41; 22, 45, 55, 167, 229, 274, 324, 326; classification of, 231–9; short staple: *see* Staple; long staple: *see* Staple; supposed origin of Upland varieties in U.S., 243. *See G. hirsutum*, New Orleans, and *G. mexicanum*, Georgian (the bulk of the Uplands are the latter rather than the former); *also* America
Uppam (or *ukkam* or *rekkam*) cottons (*G. obtusifolium, var. Wightiana*, race *Uppam, which see*), 129, 130, 146, 151–153; of Tinnevelly, 149; *uppam-parthi-chedi*, 151; and *tellapatti* cottons, comparison of, 153
URENEÆ, URENA, 53
Ushtarzai: *see* Afghanistan

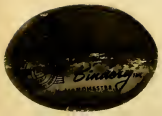
Varadi cotton (*G. arboreum, var. rosea*, hybrid, *which see also under Bani*), 112–114; origin of, 111, 113, 133, 151
Vadara, a Sanskrit name for, 9
Vellai-kanni-parthi-chedi, 130, 153
Verawal: *see* Gujarat and Kathiawar

Verdao cotton, 309
Vilayati, 96, 113
Vine-leaved cotton (*G. vitifolium, which see*), 255–65; of Driander (1782) = *G. hirsutum*, 185
VIOLA, species, hybrid and pollen grains of, 349
Virginia and Virginian cottons, 258; first attempt to grow, 18; encouragement given, 19–20; Levant cotton taken to, 81; Mogul's cotton supplied in 1621, 100; first exports from, 272

Wa-been cotton, 94
Wadhiaro, 152
Wadhwan: *see* Gujarat
Wagadio, 152
Wa-gale (Burmese) cotton, 128, 129
Wagria race (*G. obtusifolium, var. Wightiana*, hybrid), 152; 49, 133, 148, 149; Hove's Gujarat annual cotton, 145–6; Clark's experiments with, 336
Wa-gyi (Burmese) cotton, 129
Wa-ku-la of Mason, 296
Wankaner: *see* Gujarat
Watni, Ind. hill name for cotton, 125
Watt, James, 19
Wyatt, 19
Weaver, J., of Margarini plantation, 312
Weevil: *see* Diseases
'Welborn Pet,' trade name, 232, 238
West Africa: *see* Africa
'Westerns,' Madras trade name, 46
West Indies, cotton of, 7, 97, 170, 224, 227, 228, 251, 257, 285, 287, 290–2, 298, 305, 335; cotton seed conveyed to America, 18, 22, 272; Indian seed ditto, 101–2; types, grades and names of, 46, 262–4, 291; Cuba, 170, 298; St. Lucia, 216; *G. peruvianum* in, 216; Uplands in, 239; San Domingo, 252, 264; Dominica, 252; Levantine cotton in, 264; spontaneous cotton in, 267; St. Kitts, 268, 271; St. Thomas, 268; Barbados, *which see*; Bahamas, 268; Martinique, *which see*; Trinidad, 268; Porto Rico (Spanish), *which see*; acclimatisation of *G. barbadense* in, 273; Sea Island in, 275, 289; cultivation of Brazilian cotton by early planters in, 287; compared with the States, 291; 'West Indian Green-seeded,' 191; recent production in, 291–2; chief crop in, 305; improvement of stock, early experiments, 335
'White,' name given to an Egyptian cotton = *Abassi*, 45
White Nile: *see* Soudan (Egyptian).
White Siam cotton, acclimatisation of, in 1758, 190
Whitney, invention of saw-gin, 20, 188
Wild and indigenous cotton: *see* Indigenous
'Willet's Red Leaf,' trade name, 232
'Wise,' trade name, 238
Windward Islands: *see* Antilles
'Withy Wood': *see* Jamaica
Wolstenholme and Holland: quotations, 291–2
Won: *see* Nagpur
Wool (cotton), *see* Floss

Xylon: ancient name for cotton and synonym for Gossypium, 12, 59

Yangtzekiang: *see* China
Yarkand: production and manufacture of cotton in, 13; cotton of, 116, 122, 125. *See* Asia Central
Ychcaxihuitl: 255, 258
'Year round' cotton, forms of, &c., 263, 335
Yerra (red), a cotton synonym for *Nadam, which see*
Yokohama: *see* Japan
Yucatan (*see* America Central) wild cotton, 207
Yunan: *see* China
Yxomtom cotton of the Bugres of S. Brazil, 296

Zafiri, an Egyptian cotton, origin of, 214, 223
Zambesi and Zambesi expedition: cotton of, 135, 154, 185, 211, 215, 228, 251, 268, 298, 311, 317. *See* Africa East
Zanzibar; cotton of, 252. *See* Africa East

PRINTED BY
SPOTTISWOODE AND CO. LTD., NEW-STREET SQUARE
LONDON